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ELECTRIC LIGHT CURRENTS AND THE INSULATION OF CONDUCTORS.

The various installations of electric lighting in town and country have, up to the present, been made with the conducting wires arranged either overhead or underground. When wires are freely suspended in air from lamp-post to lamp-post, it is not actually necessary that they should be insulated, except at the points of support, as it is usually only in these points that the current could escape; but as they might swing against obstacles in connection with the ground, or those persons connected with the operations of electric lighting might accidentally come in contact with them, it is advisable that they should have an insulating protection throughout their length, especially when the currents produced by the dynamo-electric machine employed are of high tension. As, however, the future and permanent use of the electric light will be so arranged that the wires conveying the electric current will be placed underground, this method will form our chief consideration. Our object in dealing with this subject is to impress, not so much upon our general readers, as upon the acting representatives and engineers of electric lighting companies, who have probably had little or no experience in electrical science, the absolute necessity of securing a good and durable insulating material to protect their conductors. Many of the partial failures in the already existing installations of the electric light can, as is now well known, be directly attributed to the bad insulation of the wires used; and the employment of such wires can only be due to the want of the requisite knowledge of what is necessary on the part of those superintending such operations. Any electrician specifying for a submarine cable, would be sure to calculate the insulation suitable for his purpose to a nicety, and electric light engineers ought to be equally certain as to their own requirements. When a conductor has to be carried underground, or through pipes from which water can never be entirely kept out, the insulation must necessarily be *continuous*, and the conductor is usually covered with gutta-percha or india-rubber. Economy of material must of course be studied, but in this department it has been to a certain extent overdone. We know of many instances where conductors have been put down for carrying high tension currents, and merely covered (we cannot say insulated) with yarn and tape, the result of course being a failure. It must be quite understood that for such purposes as underground communication the conductors must be as nearly perfectly insulated as is possible, for a minute defect will in course of time develop into a fault of sufficient importance to interrupt the working of the circuit. Considering the cost of material, it is of course advisable that the covering of gutta-percha or india-rubber should be as thin as possible consistent with safety, but this must depend a great deal upon the tension of the current to be used. Both these materials have certain advantages, and regarding them from the point of insulation alone, india-rubber is the superior of the two. It is also better able to bear extremes of heat and cold, Hooper's or Henley's india-rubber cores being capable of standing in boiling water without detriment. Gutta-percha, on the contrary, becomes soft and loses its insulating capacities when heated above 100° Fah., but under water at the ordinary temperature it is practically indestructible. It is, however, not improbable that some other material much cheaper than either of the foregoing will be shortly introduced, and which will be found equally efficacious for the insulation of electric light leads. An absolutely perfect insulated conductor would be one whose insulation is the same throughout its length, but the manufacture of such a core as this is of course an impossibility.

Suppose, for example, we tested a ten-mile length of *core* (this being the technical name for an insulated wire), and it gave us a result at a certain temperature of 200 megohms (200,000,000 ohms). In the ordinary way of reduction to megohms per knot, this particular core would have an insulation resistance of 2,000 megohms per knot; but if we cut this core up into lengths of one mile each, and test them separately at the same temperature as before, we shall not find every piece give us just 2,000 megohms, as might be expected, but each length will give us a different figure—some higher, others lower. It will therefore be seen that the insulation resistance per mile of a definite length of covered wire is an average resistance of its component miles. It follows that one part of an insulated conductor may have an enormous insulation resistance, whilst a neighbouring portion may have a very low insulation, and it is these local places of low insulation which are apt to develop into faults. The best core is not always that which apparently gives the highest insulation; and, in fact, if the insulation of a gutta-percha covered core is abnormally high it is always regarded with suspicion, it being very probable that a too great percentage of some foreign material is mixed up in it during manufacture.

Electric light engineers dealing with high-tension currents must order the insulation of their conducting wires according to circumstances, remembering that a fault which may not be noticed when using 100 volts will break out if the electromotive force be increased to 200 or 250 volts, and so on in proportion. The manufacturers of submarine telegraph cables, or engineers connected with cable operations, can offer the best advice on the subject of insulation. We know of one eminent cable manufacturing company turning its attention recently to the production of conducting wires for electric lighting, the insulation of these wires being as good as can be obtained; but success of a marked character has not yet attended their efforts in this direction, as the representatives of some of our electric lighting companies have not only considered them too expensive, but have observed at the same time that such insulation as that proposed was quite unnecessary; in fact, "We have now more current than we know what to do with, and if there is any little leak in the cables it will not matter." It will be found, however, that good insulation is as necessary for making successful installations of the electric light as it is to the proper and effective working of underground or submarine telegraphs. Electric light companies must also

eventually possess what is now almost ignored—viz., the usual instruments for making electrical tests of their circuits, and competent electricians to manipulate them. It is not alone sufficient to know that a fault exists in a line, but it is absolutely essential to localise such faults, so that the minimum of time and expense shall be employed in repairing operations.

THE ELECTRIC LIGHT AT CHESTERFIELD.

ON the 1st September last the people of Chesterfield found themselves without any light in the streets. The price of gas is 4s. per 1,000 ft., and negotiations for a reduction had ended in the supply being cut off. During the whole of September the town was in darkness, and then electricity came to the rescue. On the 1st October arrangements were made with Messrs. Hammond & Co., who, with several others, had tendered to light the town, for an experiment, with eight "Brush" lights. On the 8th October these were in operation, the whole of the plant having been laid down in the short space of time of one week. The experiments were continued for three weeks, in order to try the effect of the Lane-Fox incandescent lights for street purposes. The result was highly satisfactory, and negotiations ended in a contract being signed, by which Messrs. Hammond & Co. undertook to light the whole of the streets with 22 "Brush" arc lights, and about 100 incandescent lamps, for the period of one year from the completion of the contract. This was to be done for the sum of £885, the price previously paid for gas being £900. Arrangements were made to continue the arc lighting from the temporary building which was used for the experiments, and also to light some portions of the town with "Orion" gas-oil lamps, until the necessary plant could be laid down for completely and efficiently lighting the borough.

This is a short sketch of the introduction of the electric light into the town, and we shall now proceed to describe more in detail the arrangements of this installation, which possesses considerable interest, from the fact of its being the first place of any considerable size in which the electric light has entirely superseded gas in the streets; and also that it is the first time that the incandescent light has been introduced to any extent for street purposes.

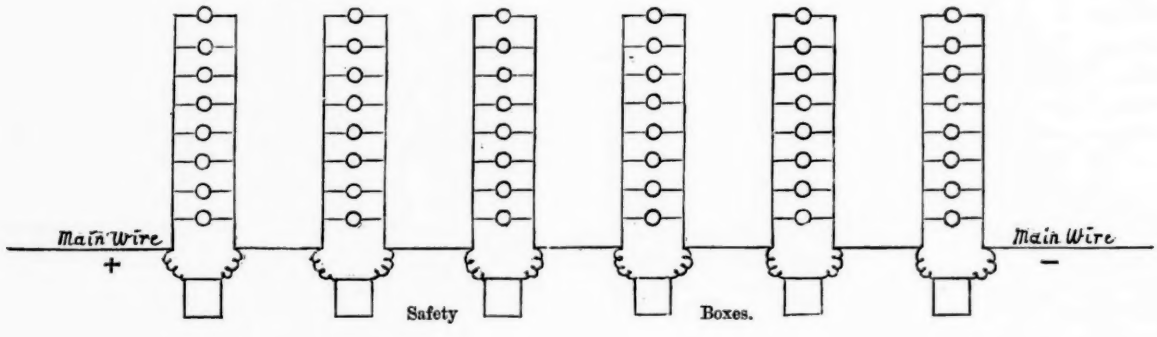
There are, in all, about nine miles of streets to light, and the question of the first importance is, obviously, what system of conductors shall be used. There is no choice between underground and overhead, as the terms of the contract preclude the use of underground wires; while in most places it may be found better to use overhead wires for a short time, and replace them with underground when the business of supplying electricity for private purposes is more fully developed.

In this installation the wires are carried almost entirely on wooden poles, varying from 26 ft. to 36 ft. in height, and having 24 in. and 33 in. arms. These are placed, for the most part, at the curbstone, and serve in many cases as lamp-posts.

Insulators are of brown stoneware, Varley's pattern. The conductors are No. 8 naked copper wire, having a conductivity of 93 per cent. and a breaking strain of 705 lbs. The average distance between the poles is 60 yards, and a minimum dip of one per cent. has been allowed, thus giving a factor of safety of four.

The arc lights are arranged alternately on two circuits, thus enabling every alternate lamp to be extinguished by means of a switch at the central station. This is done every night at 12 o'clock.

The incandescents are arranged on one circuit, in which parallels of eight lamps in multiple arc are introduced in series, thus :—

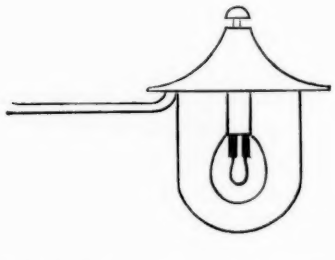


Each parallel is provided with a safety cut-out, by means of which, should two lamps in the parallel break down, the whole parallel will be short-circuited, thus obviating the danger to the other lamps of the additional current, and providing against the whole of the lamps in the circuit being put out by the breaking down of a parallel.

The main conducting wires have been carried round the town in a complete circuit, forming a sort of inner circle, and from this main line the various parallels branch out to the side streets. The length of this main line is 2,740 yards.

The arc lights are fixed partly on iron standards and partly on the posts carrying the wires, and vary in height from 14 ft. 6 in. to 26 ft. The incandescent lamps are 12 ft. 6 in. above the ground, and are placed in a special form of street lamp. This consists simply of a glass globe —or rather bell—similar to the old form of street lamp. The glass is supported by an iron bracket and covered with a metal top, which also serves as a reflector. There is thus no iron-work or frame to cast a shadow, the light being entirely surrounded with clear glass. The whole effect is very pretty.

The branch wires to each lamp consist of No. 16 copper



covered with gutta-percha, and are led into the lamp along the bracket through an india-rubber tube, which is sealed with paraffin to prevent the ingress of moisture.

The new central station is a corrugated iron building 40 ft. by 60 ft. This is divided into two portions by a wooden partition, one portion serving as office and store-room, and the other (40 ft. by 50 ft.) containing the engines and dynamos.

On the south side the upper portion is glazed along the entire length, thus giving the building a very light and airy appearance.

The engines, of which there are two, are duplicates. They are by Messrs. John Fowler and Co., of Leeds, and of that form known as their 20 horse-power semi-portable "Yorkshire" compound. They are each capable of developing 60 indicated horse-power. They are bedded on concrete and timber baulks, the baulks, 11 in. square, passing under the flooring, and the dynamos being placed on them, the engines and dynamos being thus on one perfectly rigid bed. Each engine has a 7 ft. fly-wheel and a driving pulley 8 ft. 2 in. in diameter. They make 135 revolutions per minute, the dynamos making 660.

The water supply is obtained from the river Hipper, which runs close to the building. Each engine pumps its own water direct from the river; there is also a donkey pump, capable of supplying both engines, and which is also used to keep a supply of water in a tank holding 1,100 gals., and placed at a convenient height on the outside of the building. In addition to these pumps, each boiler is supplied with an injector.

The dynamo machines—two in number—are those known as the "40-light Brush" machine. These are each capable of sustaining 40 arc lights of 2,000 candle-power on one circuit, or 320 15 candle-power incandescent lamps. Each machine is driven by a 12 in. belt direct from the driving wheel of the engine. It will be seen that the engines and dynamos being duplicates enables either one to do the work of the other. But not only is this the case, but the arc and incandescent lights are so arranged that the same current is required for each, and both arc and incandescents can be worked on the same wire by one machine; indeed, the machine can supply the whole of the lights, both arc and incandescent, and has been doing so for several days.

The wires from the machines, and the various arc and incandescent circuits, are all brought to a terminal board having plug connections, by means of which they may be joined up in any desired way either with one machine—in which case they practically form one wire—or they may be divided between the machines in any desired manner. Should a circuit break down by any means, the simple insertion of a plug cuts it off, and the others remain unaffected.

At 12 o'clock, when it is required to extinguish half the arc lights, this is done by inserting a plug, while another switch puts a shunt circuit on the field magnets of the dynamo, thus reducing the electromotive force, and keeping the current and the speed of the machine constant.

The machines are provided with Harding's patent speed indicators, which shows at any moment the exact speed at which they are running; while by means of an electro-dynamometer and a switch the strength of the current can be ascertained at any moment. Apparatus is also provided for testing the insulation and conductivity of the conductors.

The length of the main pole line is 2,740 yards, and the resistance is 3·3 ohms. It will be seen that when the circuits are joined up, so that the whole of the lights are working from one machine, the length of the main wires is 8,220 yards. To this must be added the lengths of the various branch circuits, in all nearly eleven miles of wire. We have thus the extraordinary result of one machine working 22 arc and 100 incandescent lights through a circuit of more than 15 miles, a result which we venture to say has never before been attained.

The lights burn with great steadiness and brilliancy. No better example of what can be done with one "Brush" light will be found than in the market-place. This covers an area of 57,500 square ft., and is illuminated by an ordinary lamp of 2,000 candle-power, placed at a height of 21 ft. A newspaper can be read with ease over almost the whole of this large area.

Since the 8th of October last the lights have burnt with the greatest regularity, there having been none of the breakdowns which are unfortunately often to be mentioned in connection with the electric light.

Arrangements are being made for extensive lighting of private houses, shops, &c., and the plant has been laid down with a view to this, there being ample room at the central station for extra power to meet the demand which will undoubtedly be made for electricity for many purposes.

The entire contract has been carried out under the direction and superintendence of Mr. W. Kingsland, A.S.T.E.

We hope shortly to publish some statistics as to the consumption of coal, cost of maintenance, and other matters of great practical interest.

ON THE ELECTRIC RESISTANCE OF THE GASES.

By E. EDLUND.

It appears that the electric resistance of gases is in many respects different from that of solid and liquid bodies. We shall here consider these differences and attempt to give their explanation.

1. In order that the current of an electro-motor may traverse a liquid or solid conductor, it is by no means necessary that the electromotive force should possess a certain strength. However small such force may be the current passes through the conductor, although the strength of the current decreases in proportion as the electromotive force is reduced or the resistance increased. The current ceases only with the electromotive force. With gases the relation is quite different. If the current is to traverse a gaseous body the electromotive force must produce a certain tension at the electrodes, the magnitude of which depends on the nature, the density, and the temperature of the gas, and which must not fall below a certain limit. If the tension falls below this limit the gas appears as a perfect insulator.

2. The quantity of heat which the current produces in a solid or liquid body is well known to be proportional to the square of the strength of the current. In gases, however, this quantity of heat is as the first power of the strength of the current. (See *Pogg. Ann.*, 145, p. 237, and *Wiedemann's Beiblätter*, 2, p. 720.)

3. In solid and liquid conductors the quantity of heat developed by the current is, other things being equal, inversely as the section of the conductor. In gases the heat-quantity is quite independent of the section of the gaseous column traversed.

4. In solid and liquid bodies the resistance is inversely as the section of the conductor. Wiedemann has shown experimentally that the tension at the electrodes which is necessary to send the electricity of a Holtz machine through a cylindrical tube filled with diluted gas does not depend on the diameter of the tube, the resistance of the gas being independent of the section of the gaseous column. Schultz had previously observed that the tension was almost the same in two tubes, one of which was 0·5 and the other 16 mm. in diameter.

5. In solid and liquid conductors the difference between the electroscopic tensions at two points of the conduction is proportional to the resistance between these two points multiplied by the strength of the current. Warren de la Rue and Hugo Müller have shown, on the other hand, that the tension in expanded gases is quite independent of the strength of the current. These physicists caused the strength of the current to vary between wide limits without being able to perceive the slightest difference in the tension. Hittorf came to a similar result by another process, and concluded prematurely that the resistance of a gaseous column must be inversely proportional to the strength of the current.

6. Some years ago E. Becquerel showed that the gases become conductive when raised to the temperature of redness. The current of a single element can traverse the gaseous column if the temperature is sufficiently high. Becquerel has drawn from his researches another conclusion, to which we must draw attention. If the strength of the

current traversing a gaseous column is caused to vary by the introduction of various rheostatic resistances, the resistance of the gaseous column seems to be inversely proportional to the strength of the current. If E is the electromotive force of the electro-motor, i and i_1 the strengths of the current, r and r_1 the resistances of the solid and liquid conductors introduced into the track of conduction, and z and z_1 the resistances of the gaseous column corresponding to the two intensities of the current, Becquerel, according to Ohm's law, puts

$$i = \frac{E}{r + z} \text{ and } i_1 = \frac{E}{r_1 + z_1}$$

If the gaseous column is shut out of the circuit, and if M and M_1 are the resistances which must be introduced in order to obtain the intensities of the current i and i_1, we have

$$i = \frac{E}{M} \text{ and } i_1 = \frac{E}{M_1}$$

Hence it follows that $M - r = z$, and $M_1 - r_1 = z_1$. If the calculation is carried out thus, we come really, as Becquerel's experiments prove, to the curious result that the resistance of gases is inversely proportional to the strength of the current.

The differences between solid and liquid bodies on the one hand, and gaseous bodies on the other, can be readily explained upon the unitary theory of electric phenomena proposed by the author.

The circumstance that the electromotive force, or the electric tension on the electrodes, does not require to exceed a certain limit in order that the current may traverse a solid or liquid conductor is due, according to this theory, to the fact that the true resistance which those conductors oppose to the current is proportional to the strength of such current. The demonstration of this law no longer applies in the case of gaseous bodies. As already remarked, in gases the electric tension must have a certain value, according to each case that the current may penetrate. The resistance of the gases cannot therefore be proportional to the strength of the current; nor can we assume, with Becquerel or Hittorf, that the resistance is inversely proportional to the strength of the current, otherwise the resistance of a gaseous column traversed by an infinitely small current would be excessively great. In an electric discharge, or in a closed galvanic circuit, the current is at the first moment infinitely small. Hence it would follow that the resistance at the same moment would be so great that the formation of the current could not take place. We must therefore assume that in gases—provided that the current occasions no change of temperature, &c.—the resistance is independent of the strength of the current.

According to the unitary theory the resistance is determined by the pressure which the conductor exerts upon the unit section in opposition to the propagation of the electric current. We denote this counter-pressure in a column of gas, the section and length of which are equal to unity, by k. In a column of the section a, the whole counter-pressure against the transmission of the stream $= k\,a$. (In a liquid or solid body the entire counter-pressure $= k\,i$, i signifying the entire strength of the current, and k the resistance for the unit of the strength of the current.) If h is the speed of propagation of the current, *i.e.*, the distance which it traverses in a unit of time, i the strength of the current, and δ a constant common to all bodies, we have, according to the theory, $i = \delta\,a\,h$. If $k\,a$ is multiplied by h, or $\frac{i}{\delta\,a}$, the product $\frac{k\,i}{\delta}$ is proportional to the mechanical work performed by the current in the unit of time; and if this product is multiplied by the heat-equivalent of the unit of work, we obtain an expression proportional to the quantity of heat evolved in the unit of time. It follows, therefore, from the theory that this quantity of heat is proportional to the strength of the current, but independent of the diameter of the gaseous column.

As the resistance is determined by the pressure which the conductor opposes per unit of section to the propagation of the current, and as in gases this counter-pressure is independent of the strength of the current, it is evident that the resistance has nothing to do with the magnitude of the section.

The difference between the electroscopic tensions at two points of the conductor of a current is, according to the unitary theory, proportional to the real resistance of the conductor between these points. As this resistance in gases is independent of the strength of the current, this must also be the case with the difference of the electroscopic tensions.

If r is the essential resistance in a closed circuit consisting merely of solid and liquid conductors, L the length of the track of conduction, n the section of the polar plates, E the electromotive force, and i the strength of the current, we have, according to the unitary theory for calculating the strength of the current, the differential equation,

$$L\frac{d\,i}{d\,t} = n\,E - n\,r\,i,$$

from which we obtain by integration Ohm's law: $i = \frac{E}{r}$

If, on the other hand, we have in the circuit a gaseous column, with the resistance R, we have

$$L\frac{d\,i}{d\,t} = n\,E - n\,R - n\,r\,i,$$

whence

$$i = \frac{E - R}{r}$$

The resistance R of the gaseous column is therefore in the numerator and not in the denominator, where it would stand according to Ohm's law. Hence we see that E must necessarily be greater than R if a current is to arise at all.

If in the case where the gaseous column is present in the circuit we introduce two different rheostatic resistances, we shall obtain, since i and i_1 denote the corresponding strengths of current,

$$i = \frac{E - R}{r} \text{ and } i_1 = \frac{E - R}{r_1}$$

If the gaseous column is thrown out of the circuit, and if M and M_1 are the resistances required to obtain again the strengths of current i and i_1, we have

$$i = \frac{E}{M} \text{ and } i_1 = \frac{E}{M_1}$$

whence

$$\frac{i_1}{i} = \frac{M - r}{M_1 - r_1}$$

If we then assume, with Becquerel and Hittorf, that $M - r$ and $M_1 - r_1$ represent the resistances of the gaseous column at the respective strengths of current i and i_1, we have the singular result that these resistances are inversely as the strengths of the current, though in reality they are independent of it.—*Wiedemann's Annalen.*

THE MOTIVE POWER FOR DYNAMO-ELECTRIC MACHINES AT THE CRYSTAL PALACE.

I.

ENGINEERS, both mechanical and electrical, may congratulate themselves on the success which has hitherto attended the introduction of the electric light. The ever-increasing use of this powerful source of illumination has created a demand for a special class of electricians, and the production of electricity from dynamo-electric machines driven by steam-power has recently given quite an impetus to that part of the mechanical engineering profession devoted to the construction of steam-engines. We believe it will not be uninteresting to many of our readers if we devote a portion of our columns from time to time to a series of articles bearing more particularly on the adaptability of the various classes of engines, not omitting those worked by the combustion of gas, now employed at the Crystal Palace for the purpose of

driving dynamo-electric machines. Without doubt the production of electricity by such means has been instrumental, not only in furthering the manufacture of numerous engines which would not otherwise have been required, but has actually driven engineers to design and carry out various improvements calculated to insure regularity of speed, which in all probability would never have been thought of or even considered requisite for any other purposes. The attention of many eminent engineering firms has been turned to the construction of the most economical and suitable engine for driving dynamo machines, and many successful applications have been the result. Prominent amongst those now regularly working in the Electrical Exhibition at Sydenham are the four types of engines shown by Messrs J. and H. Gwynne, to whom we are indebted for portions of our description. They have attracted a considerable amount of attention not only from persons conversant with engineering subjects, but from the general body of the public. The following may be taken as a concise and brief description of these engines, and we hope shortly to be able to give illustrations of them as actually placed in position at the Crystal Palace.

No. 1. "Invincible" direct-acting high-speed vertical engine, coupled to spindle of and combined with one Siemens D_2 dynamo-electric machine and one Siemens S D_3 machine. Engine makes 700 revolutions per minute, provides 9 to 10 actual horse-power. The dynamo machines worked by it maintain one Siemens arc lamp of 7,000 candle-power and four Siemens arc lamps of 1,000 candle-power each.

No. 2. "Invincible" direct-acting high-speed horizontal engine, combined and coupled directly with one of Siemens W_2 alternating current machines and one D_7 exciter for same. Engine makes 800 revolutions per minute, provides 10 to 12 actual horse-power. The dynamo machines worked by it maintain 6 Siemens differential arc lights and 75 incandescent lamps of the Swan system.

No. 3. "Invincible" horizontal engine, running at 280 revolutions per minute, provided with special bearing to carry properly heavy fly-wheel, and driving by straps one Siemens W_1 alternating current machine and one D_7 exciter for same. Engine makes 280 revolutions per minute, but will run at about double this speed. W_1 machine makes 700 and D_7 exciter 1,000 revolutions per minute. Actual horse-power provided at 280 revolutions, 20. The alternating current machine maintains 200 Swan incandescent lamps.

No. 4. "Invincible" high-speed engine, similar in all respects to No. 3, but arranged vertically. Engine makes 300 revolutions per minute. Drives Siemens W_1 alternating current machine and D_7 exciter. Maintains 100 Swan incandescent lamps.

These engines present a remarkable example of their ready adaptability to electrical purposes, being really constructed for an entirely different kind of work. They are widely known under their original signification of the "Invincible" Pumping Engine, and it is for this purpose that they were originally built.

These pumping engines are guaranteed to be superior in every respect to any machine for raising water, and they are the result of a practical experience in the manufacture and working of hydraulic machinery extending over a quarter of a century. All parts of the engines are accurately balanced, so that they may be run at their highest speed without the *slightest* vibration or knocking.

Their cylinders and slides are of the very best mixture of cold-blast and Scotch iron; the connecting, eccentric, and slide rods are of the best hammered steel; the cross-head and piston are of one piece of steel; the valve spindles work in guides; and the crank shaft (double bearings) is worked out of a solid block of steel. Each engine is supplied with starting valves, a set of steel spanners, condensed water cocks, impermeator, and an improved system of lubrication is attached to all the bearings.

As now shown at the Crystal Palace, the only alteration made is that the pump is removed and the dynamo-electric machine substituted. We believe these engines to have given every satisfaction; and from our own observation on several occasions, we can say that they are apparently well suited for driving dynamo-electric machines, and we see no reason why they should not attain to the same eminence for this purpose as they have long since gained as pumping engines. We may mention that the stand of Messrs. J. and H. Gwynne in the Palace is number 51.

NOTES ON THE LAW AND PRACTICE RELATING TO LETTERS PATENT FOR INVENTIONS IN THE UNITED KINGDOM.

By T. J. HANDFORD.

(*Continued from page* 246.)

VI. PROCEDURE.

(*a*) *Provisional Protection.*

The first step in the process of obtaining letters patent is to apply for provisional protection. In order to obtain this there is required a petition, a concise description (termed a provisional specification) of the invention, and a statutory declaration. The forms are set out in the Act (the Patent Law Amendment Act, 1852). The petition must bear a £5 stamp. Each application is to be limited to one invention.

The title of the invention should be well chosen, not being too indefinite on the one hand nor too restricted on the other; and the provisional specification itself should be so drawn as, while covering all the essential features of the invention, not to unduly limit the patentee in the future development of his ideas, and yet at the same time avoid such a vagueness and latitude of description as would lay the patentee open to the charge that he had not described an invention at all. Formerly it was only necessary to explain the nature of the invention in the provisional specification, but the law officers of the Crown now insist upon the applicant describing a mode of carrying it out. It is not, however, necessary to give minute details unless the novelty of the invention itself consists in improvements in details, in which case the provisional specification should be drawn accordingly.

The provisional specification is examined by one of the law officers of the Crown (the Attorney-General taking those bearing an odd number in the register, and the Solicitor-General those of an even number), and if he sees no reason to the contrary, he grants provisional protection forthwith. Occasionally he raises objections to the title and form of the provisional specification, and requires them to be amended, and in rare instances refuses altogether to grant protection. The provisional protection lasts six months, dating from the day of the application, and the patentee may during that time use and publish his invention *if expedient*, care being taken not to prejudice his interests in foreign countries if he intends to take patents abroad. It should be noted that any publicity which is given to the invention during the period of provisional protection is under the control of the patentee himself, since the provisional specification remains a sealed document in the Patent Office during the whole of that term.

(*b*) *Notice to Proceed.*

If the patentee intends to complete his patent he must give notice of such intention at least two months before the expiration of the term of provisional protection, and it is very desirable that he should do so as much earlier as practicable. The certificate of "Notice to Proceed" having been given, bears a £5 stamp. This "Notice to Proceed" is then advertised, in order to give persons interested in opposing the application an opportunity of doing so. That the invention has been obtained by fraud, that it is not new, and in particular that it is the same as an invention of the objectors, are all good and valid grounds of opposition, except when the invention has been imported from abroad, in which case the allegation of fraud is not admissible. The opposer usually files declarations in support of his opposition, and the applicant files counter-declarations in reply. The law officer (the Attorney- or Solicitor-General, as the case may be) then fixes a day for the hearing of the parties, who accordingly appear before him, either in person or by their counsel, solicitor, or agent. After having heard the arguments upon both sides, the law officer withholds or issues his warrant for the grant of the patent, as he sees fit. The refusal of a patent, however, is of very rare occurrence,

as if the law officer can distinguish any difference at all between two things alleged to be the same he will grant the patent, leaving any ulterior questions to be decided by the courts at a future time should the patent be litigated. Sometimes he will allow the patent with restricted claims, in other cases he will post-date one patent so that it shall be tributary to the other; and again, in the case of two concurrent applicants for the same invention, he will frequently grant a patent to both, on being satisfied that they are both *bonâ fide* inventors.

It should be observed, however, that oppositions are seldom resorted to, the period prescribed by the statute for entering objections being usually allowed to elapse without any interference. The fees payable in respect of oppositions are set out in the schedule to the Act.

(*c*) *Sealing.*

The ordinary opposition stage having being passed, either (as in the majority of cases) without opposition or after an unsuccessful opposition, the patentee may apply for the patent (the sealed legal document itself). Application for it must be made at least three weeks before the expiration of the term of provisional protection. Occasionally opposition is entered to a patent at this stage before the Lord Chancellor, the objections being supported by affidavits. The applicant has then to petition the Lord Chancellor to seal the patent, and support his petition by affidavits traversing the allegations of the opposer. The Lord Chancellor then either (if there has been no opposition before the law officer) refers the case to him for his decision in the usual way, or appoints a time for the hearing of the case himself, and after the arguments on both sides exercises his discretion as to granting or withholding the patent.

When an opposer allows the ordinary opposition stage to pass without entering opposition before the law officer, he must show, either that he was not aware of the existence of the application, or that if he had opposed he would have incurred the risk of opposition to an unsealed patent of his own, or give some other good and sufficient reason for his previous inaction. Further, if opposition was entered before the law officer, and he allowed the patent to pass, the opposer must make out a very strong case indeed for again obstructing the course of the patent by entering opposition before the Lord Chancellor, as it is distinctly to be understood that the jurisdiction of the Lord Chancellor is not that of a court of appeal from the decisions of the law officer.

In several cases where a second of two applicants in respect of the same invention succeeded in getting his patent sealed first, and opposed the sealing of the patent of the first applicant, the Lord Chancellor refused to grant the latter a patent. Although, however, this precedent has been somewhat departed from since, it is always safer to give "notice to proceed," and apply for the great seal as quickly as possible, instead of delaying to the full extent of the periods which the law allows for these purposes.

The warrant of the law officer for the sealing of the patent and the patent itself each bear a £5 stamp.

(*d*) *Complete Specification.*

The final step is to file in the Great Seal Patent Office a full and complete description, termed a "complete" or "final specification" of the invention. This document, which is to bear a £5 stamp, be in the form set out in the Act, and be under the hand and seal of the applicant for the patent, must be filed, with a copy thereof, within the period of provisional protection.

The specification should describe fully the best means with which the applicant is acquainted of carrying out the invention, and must omit nothing which is of importance to its practical success. It is not indeed necessary to give information with which competent persons conversant with the art or trade to which the invention relates are supposed to be acquainted, as the specification is not addressed to the public generally, but to persons possessed of *ordinary* skill in the particular line. It is always safer, however, to err on the side of an excess than on that of a paucity of information, especially in cases where the invention itself is one of a somewhat trifling character; as omissions or slight errors, that would be condoned if an ordinary workman could supply or correct them in the case of an invention of considerable magnitude, have been fatal where the invention itself has been but small, the courts holding that in such cases it is not competent to amplify or correct the specification by the superior intelligence of the reader.

When the invention relates to new machines or apparatus, or involves their use in order to carry it out, drawings of the same should be supplied, one copy on parchment and another on drawing paper, of the sizes and executed in the manner set out in the Act and rules and regulations. These, although they form a part of the specification itself, must not be taken to supersede a full *written* description of the invention, as every material part of the invention should be described *verbally* as well as illustrated by a drawing. The final specification must be complete in itself, and the patentee will not be able to claim the benefit of anything described in his provisional specification which he has omitted from his final specification, as the provisional specification, although it limits the invention as covered by the final specification, is not intended to supplement its deficiencies.

The specification, in addition to describing the manner in which the invention is to be carried out, should also specify distinctly what are the peculiar features which constitute the invention itself, and distinguish it from everything that has preceded it, so that persons reading the specification may know exactly how much of that which is described in it they are entitled to use as being within the public domain, and how much they are prohibited from using clauses termed the "claims," at the end of the specification, without the licence of the patentee. It is usual and convenient to embody this information in a clause or series of in which the patentee either expressly or impliedly disclaims everything else but certain things which constitute the essential features of his invention.

These claims, *which must not extend beyond the subject-matter of the provisional specification*, require to be drawn with great care and precision, and the language in which they are couched should be most clear and explicit, and entirely free from ambiguity. If the invention consists of a combination of old parts, or of new parts, or of old and new parts, it must be clearly defined as such in the claims, and where any of the parts are new, *per se*, they should be claimed separately, if the patentee wishes to secure them; as although it has been frequently held that the use of a new and material part of a combination constitutes an infringement of the combination itself, yet in recent decisions it has been clearly laid down that if the patentee intends to cover parts of a combination as well as the combination itself, he must claim the parts separately. In all cases, however, it is desirable to avoid a multiplicity of attenuated claims, as any one bad claim is sufficient to vitiate the patent, although where an invention possessed great merit, the courts have supported the patent, even although the specification included a claim to a subordinate part which could not fairly be sustained, the courts considering in this case that as the defective claim was subsidiary to a more important and valid claim, and the former could not be infringed without infringing the latter, the operation of the patent was not extended by the subsidiary claim being included, and that it would be consequently unfair to the patentee to deny him the benefit of his invention simply because he had included a claim which might be taken to be merely surplusage to the specification. Nevertheless, the practice which obtains in the United States of America of repeating the same claim over and over again, by simply permutating its phraseology, cannot be too strongly deprecated as applied to English usage. Let the patentee in one or more claims honestly state what he believes to be his invention, after an examination of the prior specifications relating to the subject, and especially let him avoid attempting to claim too much, by seeking under cover of vague and indefinite terms to include something which he has not yet invented, but which he thinks may eventually be evolved out of his invention, and the courts will take care to give a fair construction to his claims, so as to protect him against colourable imitations of their subject-matter.

If the patentee prefers it, instead of lodging a provisional specification with his application, he may file a complete specification at the outset with his petition and declaration, in which case he is *de facto* provisionally protected for six months from the date of his application. The subsequent

proceedings with regard to "notice to proceed" and sealing are the same as in the previous case, but of course no further specification is required to be deposited, the complete specification having been filed already. This course is, however, not to be recommended, since it is obvious that the full specification, if filed at the time of the application, must necessarily in the majority of cases be very defective; and as no amendment is admissible, the patentee is placed under a permanent disadvantage, the commercial value of his patent being in all probability seriously compromised. Apart from this fact, the complete specification is thrown open to inspection immediately it is filed, to the prejudice in many cases of the full protection of his interests abroad, whilst at the same time unscrupulous persons here, holding a current protection of prior date for an invention relating to the same subject, have the opportunity of incorporating in their final specification the substance of the specification of the subsequent patent, and thus defrauding the second patentee of his just rights.

(*To be continued.*)

CABLE OPERATIONS ON THE WEST COAST OF SOUTH AMERICA DURING THE RECENT WAR BETWEEN CHILI AND PERU.

By H. BENEST.

It may be that the relation of some experiences in cable operations during war time might not be uninteresting to some of your readers, more especially as a proposition has been recently made that the different submarine telegraph companies shall disclose the positions and tracks of their cables, which proposal may not meet with a favourable reception, inasmuch as, unless protection were promised by Governments, it would be decidedly injurious to the companies for such knowledge to become the common property of all the world.

Immediately on the declaration of war by Chili against Peru, on the 5th April, 1879, the Chilian naval authorities directed their attention towards the cables lying north of Iquique, and one of their corvettes (the *Esmeralda*) was detailed for the express purpose of grappling for and cutting the cables. Success did not, however, attend their first endeavours, for they were some two or three weeks before the cable from Iquique to Arica was eventually found in Iquique Bay, and severed. They had no appliances in the way of grapnels or suitable rope, small kedge anchors being used at first. Subsequently, proper grapnels were made, and the Chilians became rather smart at fishing up, and not only severing, but taking out portions of cable, the belief being prevalent, that by some occult means the cable would "grow" together again after being cut should the ends be left in close proximity.

A rumour was current that the Chilian authorities had actually offered a heavy reward for such information as would enable them to find and cut any of the cables on the Peruvian coast, sums of 10,000 and 20,000 pesos being freely spoken of as the amounts. Certain it is that the Peruvians who were at that time blockaded in Iquique had evidence that some one had assisted the Chilians in their search off the port. A man residing in Iquique, and conducting a business of supplying both water and whiskey to thirsty sailors, was the object of their suspicion. This individual, whose name has for the moment escaped the writer, also owned a hulk, on board which he condensed from the sea fresh water for the supply of vessels in the harbour. He was also the leading pilot for the port, and was a man of some little importance.

After the first famous naval engagement, between the *Huascar* and *Independencia* on the Peruvian side, and *Esmeralda* and *Covadonga* on the Chilian side, in which the *Esmeralda* was sunk in Iquique Bay, the enraged Peruvians "went for" the *ci-devant* pilot's whiskey saloon on shore, and also his water distilling establishment afloat; his family were banished, and he himself, it was stated, made his escape on the *Covadonga*, which vessel he, so it was said, actually piloted in her escape from the *Independencia*, leading the latter ship ashore on a reef off Punta Greusa, and causing her total loss. On board the hulk, when the Peruvians went to destroy her, was found several coils of cable, which constituted, they declared, damning evidence against the proprietor.

The writer believes that this man had acquired some knowledge of cable-work as cable-hand on board a repairing ship in Australia. He had, by virtue of this slight knowledge, been employed by Mr. Parsoné, the manager of the West Coast Co.'s cables on one occasion prior to the arrival of the *Retriever*, as leading hand in the temporary repair of the Iquique-Arica section, ruptured by the earthquake in May, 1877. A barge and a steam cutter were engaged upon this work.

So much for the rumoured intentions of the Chilian authorities, and the agency through which they were supposed to have accomplished the first interruption of communication between the beleagured Peruvians and their base of supplies and head-quarters. This, the first case of interruption caused by the Chilians was, however, re-established by the superintendent of the station (Mr. Burt), who managed to raise the broken ends of the Northern cable and insert a piece of old deep-sea type taken from the underground line on shore, and kept going until the resumption of the blockade by the Chilians, when, having suspicion or knowledge that the section was in working order, the Chilian ironclad *Almirante Cochrane* (?), together with the sloop of war *Covadonga*, grappled for and cut the cable farther to the north in some 30 odd fathoms, causing the second interruption. An extract from a diary referring to the *repair* of this cable more than a year afterwards may be of interest.

July 28th, 1880. Iquique.—Hove up anchor and proceeded to grapple for cable; got it almost immediately; cut and tested it; buoyed Arica end at 12 noon.... got north end and picked up until we had the piece of *deep sea* which was inserted in it; also picked up a kedge anchor on the cable, with a piece of Manila rope attached.... July 29th.—After picking up south end, went for buoy with north end which we picked up till we came to another *cut* in the intermediate, cut by a hack saw (on board the *Cochrane*), so it was reported.

The next and third attempt, making four cables cut through by the Chilians, took place off Arica, where several days were occupied by a Chilian war vessel, the *Covadonga*, it was stated, in finding and cutting through both cables, *i.e.*, the cable from Arica to Iquique, south. and Arica to Mollendo, north. This time the operations were assisted by two Chilian officers who had been present, in 1875, as guests during the landing of shore ends and subsequent "laying" out from the port; these gentlemen, doubtless, had retained some recollection of the direction taken by the steamer when leaving the land. The *Covadonga* distinguished herself by effecting most of the cutting operations from this time, so it was reported.

After the departure of the Chilian ships the superintendent of the Arica station, Mr. T. S. Tuffield, immediately chartered a barge, and assisted by a small steam cutter, which had escaped the searching eyes of the enemy, put off to the spot where he had observed the Chilians operating, and succeeded in fishing up one of the recently severed ends (that of the northern section to Mollendo) in something like 50 fathoms of water. This end he kept in the barge and brought the other end to the surface, but was unable to join up owing to some cause with which the writer is imperfectly acquainted. (The Chilians had not upon this occasion taken out any cable.) Communication was kept up through Mollendo with Lima from the barge, for some weeks, the little steamer carrying the messages to and from the shore. The British flag was hoisted on the barge with the intention of apprising the Chilian ships of the nationality of the crew should they have unexpectedly appeared upon the scene, and conceived a notion of firing upon what would doubtless present a suspicious appearance.

The Chilians found out eventually that communication had been re-established from Arica northwards, and to effectually put a stop to it proceeded to cut the cable off Mollendo; likewise dredging for the other broken ends at Iquique and Arica, dragging them apart, and in some cases taking out quantities of cable, so that "sample" pieces became quite common among naval gentry at that time.

On one occasion a heavy reinforcement was despatched from Valparaiso with the object, it is said, of assisting in the capture of Arica. The Peruvians got information by some mysterious means of the exact time of the departure of the

expedition, and were consequently able to frustrate its object. The Chilians declared that it was impossible the information could have been conveyed by other means than the cable, as the intention had been kept strictly secret until the actual starting of the ships.

Tremendous excitement was the result, and the West Coast of America Telegraph Company's office at Valparaiso was in danger of being attacked by the mob, but fortunately the manager, Mr. E. W. Parsoné, was able to refute the allegation and prove that this was not the case, as it was shown that several sections were then out of circuit, nevertheless there were many who asserted that the cables had been joined by some means, and intelligence transmitted through to the enemy.

The Chilians had it pretty much their own way with the cables, but a little has to be related *contra cuenta*. While a division of Chilian troops occupied Antofagasta the Peruvian Admiral (then Captain) Grau, in command of the famous *Huascar*, steamed into the bay one night and grappled for the Antofagasta-Caldera cable lying to the south, intending to cut off communication with Valparaiso and Santiago, the capital of Chili.

The cable was raised, and the bight taken on board, and Captain Grau himself severed it in twain with a huge axe; then, after putting a few shells into the town, nearly sinking a Chilian steamer, and otherwise creating quite a lively diversion, steamed away quite satisfied that he had put "one in" for the grasping foe. He however had reckoned without his host, for there happened to be *two* cables, both leading out to the westward with just sufficient divergence to ensure the recovery of either one or the other by those with local knowledge, and correct data in the way of track, charts, &c. The wrong cable it was that had been fished up and so carefully and thoroughly cut by the gallant Captain Grau. Whether he hesitated to venture so close to the enemy's position, which was shortly afterwards defended by one or two heavy guns, and moreover, constantly guarded by a Chilian ironclad, does not appear, but certainly the Peruvians did not again distinguish themselves during the war by cutting and hacking at telegraph cables. Admiral Grau was acquainted intimately with all the parts on the coast, as he had previously commanded one of the Pacific Steam Navigation Company's steamers trading between Panama and Valparaiso. Had Grau succeeded in cutting the south cable, in all probability six or seven transports would have fallen into his hands, materially changing the aspect of the war. Intelligence of his proximity delayed their departure.

As the war progressed, and the victorious Chilians carried by storm, or otherwise gained possession of, the ports and provinces on the Peruvian coast, they were clamorous for communication by cable between the captured places and their capital (Santiago). With all their experience in the destructive part they had not sufficient constructive ability to effect the necessary repairs.

Their land lines, which had been erected at great cost, and with the avowed intention of supplanting the cables, were, from a variety of causes, extremely unreliable, and in some instances useless. During the war, and while the Chilian forces occupied Iquique, the Supreme Government of Chili ordered the *Retriever* north to carry out the repair of the Antofagasta-Iquique section. Operations were commenced in the bay, off Antofagasta, at the spot where the gallant Grau himself cut the cable. The work was continued in Iquique Bay, where the cable had been severed by the *Esmeralda*, and the ends dragged apart by the *Covadonga*. During these repairs it was found that half a mile of intermediate cable had been taken out of the circuit.

H.M.S. *Shannon* was at anchor in Iquique Bay during the operations off that port. H.M.S. *Turquoise* also arrived just upon the conclusion.

Although the company's steamer was on the spot, and application was made to Admiral Patricio Lynch, the Chilian commander, to repair the northern section, she was not allowed to touch this (Iquique-Arica) cable. Arica at that time was occupied by the Peruvians, who held it until July of the following year, 1880. While out removing a mark buoy from the northern cable, which had been picked up while grappling in the bay, the steamer was watched, and on her return to the port, Mr. Parsoné was closely questioned as to his proceedings.

During the six months subsequent to this repair, nothing was done either to destroy or repair cables by either Chilians or Peruvians, the latter power having, in fact, but one solitary vessel left, the *Union*, which remained safely moored within the Muette de Arsena at Callao.

Immediately upon the capture of Arica, the Chilian Government again ordered the *Retriever* to repair the Iquique-Arica section. This repair established direct communication with all the principal ports to the southward, giving the Chilian commander telegraphic service with the Government.

The Chilians were now free to move upon Lima. They displayed great activity, and their plans were pretty freely discussed by the public, more especially that section of the community whose business led them from place to place along the coast from Panama southwards. It was part of the Chilian plan to take the island of San Lorenzo, which protects the harbour of Callao from the sea, to fortify it, and to commence the siege of Callao by bombarding it from this point. To facilitate operations, and to place the besiegers in direct communication with their base (Arica), it was proposed to raise the cable off Chorillos (the landing place of the cable near Callao), and place it on the Island of San Lorenzo. Part of the programme, also, was to cut out Mollendo, an intermediate port in possession of the Peruvians, by joining the cables off that place, thereby making one section from Callao, or rather San Lorenzo, to Arica.

It was further rumoured that a Chilian Government steamer was detailed for the express purpose of making this diversion of cable at Chorillos, but a total want of knowledge as to the whereabouts of the cable hindered them from making the attempt. The intention, however, was by no means abandoned, until the final blow was struck, and Lima fell to a long and well-sustained attack by the Chilian army, which had marched upon that city from a point some twenty miles south of Chorillos, no complete occupation of the island of San Lorenzo having been carried out.

After this severe blow to the Peruvian power Mollendo was abandoned, and all the cables were, as soon as possible, repaired by the company's steamer.

The fact of all the records and charts being held by the company's agents in close secrecy, the interruptions above referred to were only carried out with considerable difficulty. Had this information been public property, that is to say, had the tracks been plotted upon the admiralty charts, the company's property would have suffered to a much greater extent, owing to the interruptions being accomplished in less time and the cables being probably cut in a great many more places. This would tend to prove how ill advised, in the interest of telegraph companies, it is to supply this information to the public without, in the first case, obtaining a Government guarantee that they will not suffer from the loss occasioned by this publicity.

To summarise the interruptions from the commencement of the war, the first cutting by the Chilians was made by their corvette *Esmeralda* in May, 1879, at Iquique, when both north and south sections were severed, although the advantage gained by the Chilians having cut the south section is not very apparent, seeing that Antofagasta was held by a Chilian division, but so suspicious were the latter that intelligence might be transmitted to the enemy, even from among their midst, that the then commandant at Antofagasta actually sealed the end of the cable to Iquique, after knowing it to be cut off the latter port by a vessel of their own fleet.

The second cutting was on the Arica-Iquique and Arica-Mollendo sections, when two cables were likewise ruthlessly severed, and the ends dragged apart.

The third was on the Mollendo-Arica and Mollendo-Chorillos sections, when both cables were treated in a similar manner to the ones previously interrupted.

The Peruvians, as related, succeeded but once in cutting a cable. With this one instance, seven cables in all were grappled and cut by the belligerents, the interruptions extending over two years.

The first repair by the company's steamer was made in November-December, 1879, seven months after the outbreak of the war, when the Antofagasta-Iquique section was put in order.

The second repair was in July and August, 1880, sixteen

months after the outbreak of the war, when the cables were put in order as far as Arica.

The third and final repairs consequent upon the cutting of the cables by the belligerents was in February and March and completed during April, 1881, over two years after the outbreak of the war.

The English Government would not commit themselves to any advice in the matter. Ministers and consuls abroad alike maintaining a policy of "masterly inactivity" where any question of infringement of Neutrality Laws or private rights arose.

Did governments guarantee the protection of cables in time of war, or did they indemnify in case of loss from damage they may do by cutting cables, it would then be immaterial whether the tracks of cables were made public. But while companies have no redress in these cases, it would appear to be the companies' best policy to keep the particulars of their cables to themselves, and save their property for at least as long as it would take the belligerents to find out their positions.

Even as the matter stands, companies undergo such hardships in case of war that international legislation is absolutely necessary.

The difficulty of preventing the cutting of cables by placing ships of war to watch is obvious. It would necessitate an extensive fleet being employed for such a purpose alone.

From the above relation of facts, it will be seen that the first necessity in cutting cables to interrupt communication is a knowledge of their position. Let this knowledge be attainable by simply purchasing admiralty charts, with the soundings and tracks of cables accurately laid down, the rest of the work becomes easy; a day, nay, an hour will then accomplish what would otherwise occupy weeks to do, and under certain conditions be impossible.

If the Government, as suggested, will exercise a protecting power over cable property, or an International Congress be formed for mutual agreement respecting the course to be adopted during war time between belligerents who have cables connecting their capitals, or other parts of their dominions, then, after a clear understanding has been arrived at, let the tracks of cables be plotted upon admiralty charts, and become the common property of all the world in all civilised parts of the globe.

But, in the experiences above recited, the writer hopes that cause has been clearly shown for not making public information regarding the routes followed by the telegraph cables of the world.

LEGISLATION FOR CABLE PROPERTY.

A COPY of the "Clauses embodying the Provisions which the Companies wish to see made Law" for the protection of cable property has been handed to us. Although there are several of them which are open to criticism, we propose only to make a few further remarks on the subject, and then to leave the matter until it has received the consideration and judgment of the Board of Trade. They run as follows:—

1. In the construction and for the purposes of the following sections (if not inconsistent with the context or subject matter) the following items shall have the respective meanings hereinafter assigned to them, that is to say:—

"Her Majesty's Dominions," "The United Kingdom," "The Board of Trade," "Master," "Qualified Pilot," and "Person" shall have the said respective meanings given to them in "The Merchant Shipping Act, 1854."

"Ship" shall include every description of vessel used in navigation.

"Submarine cable" shall include all cables and wires used or employed in connection with any electric or magnetic telegraph for the purposes of communication, and shall be limited to such part thereof as is covered by the sea at any state of the tide.

"Telegraph ships" shall include all ships employed in the laying or repairing of submarine cables.

"Telegraph gear" shall include all buoys, boats, machines, ropes, tackle, and other things used or employed for the purpose of laying or repairing, or otherwise in connection with telegraph cables.

"Nets" shall include all lines and apparatus other than trawls used in fishing.

"British ship" shall mean ship within the meaning of the 18th section of "The Merchant Shipping Act, 1854."

2. Any person or persons by whom a cable or cables has been or shall hereinafter be laid, shall forthwith inform the Board of Trade of the same, and shall indicate as exactly as possible, and in such manner as the Board of Trade shall prescribe, the place and line of such cable or cables, and the Board of Trade shall on receipt of such information cause the place of such cable or cables to be marked on a chart or charts to be prepared, certified, and kept as the Board of Trade shall direct, and the Board of Trade shall give publicity to the said chart or charts, and to copies of the same, in such manner as they shall from time to time determine, provided that if at any time such cable or cables shall be removed or shall cease to be worked, the owner or owners thereof shall forthwith give notice thereof to the Board of Trade, and the Board of Trade shall cause the said chart or charts to be amended accordingly.

3. The following rules shall be observed as to all British ships and persons navigating the same:—

(1.) It shall not be lawful for any ship to anchor at any place within one mile of a submarine cable as indicated on the chart or charts certified as aforesaid, unless in case of necessity arising from stress of weather or other sufficient cause.

(2.) It shall not be lawful for any ship, whether employed in fishing or otherwise, to approach any telegraph ship or telegraph gear used or employed in laying or repairing a submarine cable or cables, so as to impede, obstruct, or interfere with such use or employment of the said ship or gear.

(3.) If a submarine cable or telegraph gear shall be fouled by any anchor, trawl, or net, the person or persons fouling such cable or gear shall use the utmost care to do as little injury as possible to the same.

(4.) All persons navigating ships used or employed in fishing, shall, so far as is reasonably possible, avoid dragging with anchors or trawls at or near the place or line of a submarine cable as indicated on the said chart, and shall use the utmost care not to foul or injure such cables, and if they shall, notwithstanding such care, foul any such cable, shall use the utmost care to do as little injury to such cable as possible.

4. If any person wilfully or negligently commits any of the following offences, that is to say:—

(1.) Destroys, cuts, injures or damages a submarine cable, telegraph ship or telegraph gear.

(2.) Removes, alters, or otherwise interferes with, any telegraph ship or telegraph gear used or employed in connection with a submarine cable.

He shall be liable to pay damages in respect thereof to the owner or owners of the said telegraph ship or gear, to be assessed and recovered as hereinafter provided.

5. If any person wilfully or negligently disobeys or contravenes any of the rules hereinbefore laid down, he shall, in addition to making good any damage so occasioned, for each offence incur a penalty not exceeding fifty pounds.

6. In any case in which it shall be alleged that any person has been using, or that he intends to use, in a place or on the line indicated as the place or line of a submarine cable on the chart above mentioned, a trawl likely, either from its construction or from its condition, to be unduly dangerous to such cable, it shall be lawful for the chief officer of customs in any place in Her Majesty's dominions, if and so long as he shall be of opinion that the said trawl is and remains unduly dangerous, to order that the same shall not be used in such proximity to such submarine cable as, in the judgment of such officer, involves risk of damage to such cable, and any person disobeying such order shall incur for each offence a penalty not exceeding fifty pounds.

7. If the person or persons navigating any ship shall foul a submarine cable, a telegraph ship, or any telegraph gear, notwithstanding due care to avoid so doing, and shall thereupon, for the purpose of avoiding damage to such cable, telegraph ship, or telegraph gear, necessarily abandon, lose, or damage any anchors, chains, cables, tackle or other gear belonging to such ship, full compensation shall be made by the owners of such submarine cable, telegraph ship or telegraph gear, for the property thus necessarily abandoned, lost or damaged, and may be recovered as damages by the persons entitled thereto in manner hereinafter provided.

8. The word "property" in the 527th section of "The Merchant Shipping Act, 1854," shall be deemed and held to include submarine cables, telegraph ships, and telegraph gear.

9. No owner of any ship shall, under the provisions hereof, be answerable for loss or damage occasioned by the negligence of any person employed on board the said ship other than the master thereof, and no owner or master of any ship shall be answerable to any person whatever for any such loss or damage occasioned by the fault or incapacity of any qualified pilot acting in charge of such ship within any district where the employment of such pilot is compulsory by law.

10. All damages under the foregoing sections shall be recoverable in the same courts and in the same manner as damages alleged to have been done or caused by any British ship to property belonging to a British subject or subjects are now recoverable.

11. All penalties imposed by the foregoing sections shall be recovered and enforced summarily in like manner as penalties under "The Merchant Shipping Act, 1854," and the Acts amending the same.

As to the second clause, it appears to us that it would be most injudicious on the part of the companies to supply such information and charts as are required by the above clause, without first getting the Government to accept in principle the protection of submarine telegraph lines. Should the companies supply such information, for publication on the Admiralty charts, they will virtually destroy the only protection they have in the event of war. The experience gained during the war between Peru and Chili demonstrated

to the West Coast of America Telegraph Company the advantage of having the routes followed by their cables unknown to either of the belligerents. We are informed that the Chilian Government offered a heavy reward for information as to the position of the cables laid in Peruvian waters. Mr. H. Benest, who was on the west coast of South America at the time of that war, has kindly furnished us with a valuable paper on the subject, which will be found in another part of the present issue of this journal.

As regards "distinguishing" lights for telegraph ships while at work, those of the telegraph companies represented at 66, Old Broad Street, desire that these lights shall be red, white, and red, as they say all sailors for many years have been familiar with these colours as constituting *the telegraph flag* of the mercantile marine; and if the lights were shown in the same order they would be at once recognised and reported as those of a telegraph ship at work, and such information would often be of the greatest value to cable manufacturers, telegraph companies, and underwriters. We decidedly think that it would be a wrong move to make to alter the lights from three red ones, for these are now beginning to be pretty well understood. Before concluding these remarks, we would add that, although we have strongly advocated in our previous articles the rights of *first-comers*, we would much prefer to see matters left as they at present are, than to witness the creation of any inefficient, and therefore probably abortive, half-measures.

HOW THE ELECTRIC LIGHT IS PRODUCED.

IT does not often fall to our lot to look upon the science we devote our columns to from a comical point of view, but we feel compelled to call attention to two articles under the above title, which appeared in our contemporary the *Engineer, vide* issues of March 31st and April 7th. These articles were written with a view of imparting to the general public an intelligent idea of how the electric light is produced. The limited space at our disposal will not allow us to bring these articles *in extenso* before our readers' notice, but we extract portions which will give a good idea of the amusing character of the remainder. The writer commences in a style which would induce one to believe that he was seriously intent on his object, and he leads off as follows :—

We have recently had so many questions put to us concerning the production of the electric light, that we have arrived at the conclusion that by far the greater number of engineers know next to nothing about electricity. It is not intended for the use of electricians, who, if they read it, will one and all complain that we have left a great deal unsaid that ought to have been said. But it is just because electricians have hitherto insisted on saying a great deal that thousands of persons know nothing about the electric light, although they are otherwise well informed. For example, we know by personal experience that the dynamo is regarded as quite similar to the plate-glass frictional machine; and that it is generally supposed that the electricity is got out of it by something which rubs on something else. The same ignorance exists with regard to lamps.

After the introduction to his subject the writer proceeds to set forth his ideas for the guidance of the public in a series of propositions, and he starts with the following brief and lucid statements :—

(1) No one knows what electricity is; but for practical purposes it is convenient to regard it as a fluid.

(2) No one knows what a current of electricity is; but for convenience it may be regarded in the same light as a current of water flowing through a pipe.

In proposition (3) he volunteers the information that silver is too dear for electrical use, that copper is the best conductor that can be had for the money; and then apparently ignoring the title of his article, he informs us that iron answers well enough for overhead telegraph lines.

Then follow two funny paragraphs which, however, appear slightly contradictory.

(5) No one knows what magnetism is; but magnetism and electricity are nearly akin. When we see smoke we augur that fire is not far off. In like manner, when we see a magnet, we may take it for granted that electricity is close by.

(6) The magnetic fluid is spoken of now and then; but, unlike electricity, magnetism does not very closely resemble in its action that of a fluid.

In the first paragraph the writer states that Cæsar and Pompey are very much alike, we mean that magnetism and electricity are nearly akin, but in the last sentence he entirely negatives this. It is something for electricians to brood over, that fact about the observation taken on a magnet. In explaining the various methods by means of which electricity can be produced the public instructor says :—

(7) Electricity can be obtained in three principal different ways. First, by rubbing glass or sealing-wax with a silk handkerchief or cat's fur; secondly, by putting two substances, one of which is more readily attacked by oxygen than the other, in an oxidising fluid, and so making what is called a "galvanic battery;" and, thirdly, by the use of what is known as the dynamo-electric machine, now called "dynamo" for shortness.

(8) Frictional electricity, that is to say, electricity obtained by rubbing glass or sealing-wax, is useless for obtaining the electric light. We think it better not to explain why, because to do so we should have to say a good deal about quantity and intensity. Such of our readers as want to know more than we tell them here will find plenty of books which will give up treasures of information if they are consulted in a proper spirit.

In dealing with the first case, it seems to us that an important omission was made in not describing that well-known experiment of stroking the fur on a cat's back, more especially as the article in question appeals to the populace at large, and specimens of the feline race may be found in almost every domicile. It is also to be regretted that a proper explanation was not given as to the futility of endeavouring to apply such electricity for the purposes of electric lighting.

(9) Electricity is obtained for the electric light by the use of dynamos at present. It is probable, however, that batteries will be used ere long for this purpose, and we shall say something about them before we have done.

(10) The dynamo is *not* a frictional machine—see (8) above.

(11) Every magnet, whatever its form, has two poles, one of which, if the magnet were freely suspended, would point towards the north, the other towards the south.

The worst portion contained in the three propositions above is, that the writer threatens the public with the infliction of *something* upon batteries. We wonder whether the able instructor of those in search of electrical science popularised ever came across a certain form of magnet with three poles ?

(20) *Currents of electricity are always established in coils of insulated copper wire when they are made to pass through a magnetic field.* One current is set up in one direction when the coil goes into the field, and another current is set up in the opposite direction when the coil comes out of the field.

(21) A coil of insulated copper wire meets with a great deal of resistance in passing through a magnetic field, not because the magnet attracts it, for copper is not attracted by magnets. The resistance is as though the coil were dragged through thick treacle.

Here the writer forgets to inform the public as to whether the currents are established in coils of insulated copper wire where the circuit is open, and he also treats as a matter of indifference the important information concerning the winding of these coils, whether at right angles to the magnetic field or not. Following upon these extracts the writer describes the principles and construction of dynamo-electric machines, and we can assure our readers that the comic element is quite as apparent here as at the commencement. The diagrams which illustrate parts of the paper are also unique in their way. Whenever a battery cell is shown it has a copper plate between two zincs, the connecting wires being led off from the zincs. In his second article the writer treats upon the production of the light, and he modestly says :—

It is, perhaps, hardly necessary, but it may be useful, to add that neither this nor the preceding article is intended for the perusal of electricians. They have been written for the express benefit of that numerous class who, while wishful to obtain information concerning the principles involved in electric lighting, have no time to read books, which, however elementary, contain much more than is actually necessary to satisfy the reader's purpose.

The information contained in the remainder of this paper is about as intelligent as that in the preceding one. We are told in one case that the diamond is a form of carbon, but that it cannot be used for electric lighting because it is too dear. Again, if we introduce a length of *slate* into a circuit so as to form part of it, the slate would be heated and broken up. The following is a trustworthy and simple explanation of the working of electric lamps :—

(45) The carbons waste slowly away, the positive fastest. The rate of waste depends on various conditions. In good lamps a $\frac{3}{8}$in.

carbon will waste at the rate of about 1 in. per hour. The points of the carbons tend to get further apart, and at last they would be so far removed from each other that the light would go out. To prevent this, all arc lamps are fitted with an automatic device by which the carbons are adjusted to each other. These devices are legion in number. They all depend on the same principle for their action. As the carbons get further and further apart the resistance increases, and at last a point is reached when a portion of the current is shunted into the coils of a small electro-magnet, which acts on the mechanism of the lamp, sets it in motion, and readjusts the carbons to each other. It is this act of readjustment which causes the "flicker" or wink to be seen every now and then with most arc lamps. The better the adjusting gear the less often will the lamp wink or flicker.

(46) In conclusion, the electric lamp, no matter what its form, or whether "incandescent" or "arc," depends for its action on the fact that when a portion of a circuit offers a resistance to the passage of an electric current, the resisting portion becomes intensely heated.

Seriously speaking, we think that our contemporary has made a great mistake in publishing such extreme nonsense as is found contained in the articles we have drawn attention to, and which could not in justice be called even lectures to children. The public require information doubtless on these subjects, but let it be written by some one having at least a moderate knowledge of electrical science. Fallacious and misleading statements are worse than useless to the people, as it gives them the trouble of going over the ground a second time when searching for genuine instruction. In conclusion, we will slightly alter one of the sentences at the commencement of these articles, and assure the writer that had he expressed himself to the effect that a "great deal had been said which should have been left unsaid," he would have been much nearer the truth.

THE FIRE UNDERWRITERS' REGULATIONS RESPECTING THE USE OF THE ELECTRIC LIGHT IN NEW YORK.

In a short article dealing with the question of the dangers to be apprehended in using electric currents for the production of light, the Journal of the Franklin Institute gives the following information, which will be of interest to electric lighting companies in this country.

"The New York Board of Fire Underwriters has taken a strong interest in the above question, and through a special committee, appointed for the purpose, they have adopted a set of regulations to govern the introduction and use of electric lights. From the nature of this organisation it was to be expected that they would consider the subject from a strictly business standpoint, as their interest in it is based on purely monetary considerations. An examination of the regulations adopted as a standard by the Board confirms this view. They enter into the most elaborate details respecting the precautions to be taken to guard against danger, including therein the questions of the capacity of conductors, the proper methods of insulation, the protection of the lights, &c. In this respect the regulations established by the New York Board of Fire Underwriters will be found useful in connection with the report of the Committee of the Franklin Institute, published in their journal of December, 1881." The regulations of the underwriters, embracing the latest revisions as adopted at a meeting held January 12th, 1882, are as follows:—

Capacity of Conductors.

For Arc Lights.—The conductor must have a weight per running foot at least equal to that of the wire (or parallel group of wires) constituting the main circuit of the magnetic regulator of the electric lamps, or of the armature of the machine employed, whichever of these is the largest.

For Incandescent Lights.—Wherever a connection is made between a larger and a smaller conductor at the entrance to or within a building, some approved automatic device must be introduced in the circuit of the smaller conductor, whereby it shall be interrupted whenever the current passing through it is in excess of its safe carrying capacity.

The safe carrying capacity of a wire is that current which it will convey without becoming painfully warm when grasped in the closed hand.

Insulation.

All wires, machines, and lamps to be so mounted and secured as to insure complete and continuous insulation, with the exception of those parts (such as portions of the lamps or machines, for example) where insulation is impossible, and in this case accidental contact with exterior objects must be prevented by appropriate screens or the like.

In no case must "ground circuits" be employed, or any portion of the system be allowed to come into conducting connection with the earth through water or gas pipes, or otherwise.

Exposed wires must be covered with at least two coatings, one of insulating material next the wire, of a thickness and material approved by the Board, and another outside of this, of a material calculated to protect the former from abrasion or other mechanical injury.

Where there is a possible exposure to water, the first or second coating must be impervious to that fluid.

Wherever electricity is carried into a building by conductors from an exterior source, a "cut out" must be provided at a point as near as possible to the entrance to such building.

The outgoing and returning wires for arc lights should enter and leave each building at points at least one foot from each other.

The wires passing through the exterior walls of a building should be firmly incased in substantial tubes of non-conducting material, not liable to absorb moisture, and placed in such a manner as to prevent rain-water from entering the building along the wire.

In running along walls and the like wires should be rigidly attached to the same by non-conducting fastenings (the wires themselves being well insulated), and should not be hung from projecting insulators in loose loops.

All wires should be placed at a distance of eight inches for arc lights and two and one-half inches for incandescent lights from each other, and wherever they approach any other wire or conducting body capable of furnishing another circuit or ground connection, they must be rigidly secured and separated from the same by some continuous solid non-conductor, such as dry wood, of at least one half inch in thickness.

Wherever wires are carried through walls, floors, or partitions in buildings, they must be surrounded by a special insulating tube of substantial material.

All joints in wires must be made in such a manner as to secure a perfect and durable contact. Continuous wires (without joints) to be used as far as possible.

Globes.

Arc lights must be protected by glass globes, inclosed at the bottom to prevent the fall of ignited particles, and where inflammable materials are present below the lamps, a wire netting must be added, to keep the parts of the globe in place, in case of its fracture during use.

All broken and cracked globes to be at once replaced by perfect globes.

In show-windows and other places where inflammable materials are near the lights, spark arresters shall be placed at the top of the globes.

Automatic Shunt.

Wherever a current of such high electromotive force is employed that if concentrated on one lamp of the series it would produce an arc capable of destroying or fusing parts of such lamp, an automatic switch must be introduced in each lamp, by which it will be thrown out of circuit before the arc approaches any such dangerous extent.

Companies furnishing electricity from central stations must enter into an agreement with the New York Board of Fire Underwriters, binding themselves to test their lines for ground connections at least *once* every day (and preferably three times per day), and to report the result of such tests to the Board weekly.

Means by which those in charge of the dynamo-electric machines will be warned of any excessive flow of current, or means whereby the same will be automatically checked, must in all cases be provided.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

ELECTRICAL UNITS.

To the Editors of The Electrical Review.

Dear Sirs,—I am sure that all amateur electricians will be very glad to hear that Professor S. Thompson hopes "before long to write a 'plain, unvarnished tale,' which may afford the explanations desired concerning the accepted units." It is exactly what is required, and I only hope that Professor Thompson, in carrying out his intention, may act up to the letter of his statement, and make the tale really a "plain, unvarnished" one. I am inclined to think that Professor Thompson, like many persons in his position, judge the

capabilities of others by his own capacity, and cannot understand why beginners should not comprehend what seems so clear to himself. In making the remarks I did I have only stated what others have again and again expressed to myself with reference to the subject in question. It may appear to Professor Thompson that a beginner must be devoid of a large amount of common sense to take the view I have assumed concerning the meaning of a unit magnetic pole; but all I can say is that if such is the case the number of those who can be considered as of fair average ability is very small. Before going further, let me point out to Professor S. Thompson that he has mistaken what I said with reference to the unit magnetic pole. If he will refer again to the Review he will see that I did not advocate that the definition of a "unit magnetic pole" should be "a pole of such a strength as would support a certain weight." What I did say was that "a *learner expects* to be told that it is a strength that will support a definite weight." I am quite aware that the learner in question is quite wrong in anticipating that such will be the definition; but I know for a fact that the number of learners who expect an answer of such an incorrect kind are by no means to be counted at the ends of the fingers, though perhaps Professor Thompson, from not having worked in the same sphere as I myself have, is quite unaware of it. As a considerable portion of Professor Thompson's criticism is based on the misapprehension that I find fault with the existing units it will not be necessary for me to say more on this particular point.

Prof. Thompson quotes the following example as an instance of an explanation made clear by the help of numerals:—"*Thus, suppose there are two magnets,* A *and* B, *whose strengths we compare by making them act upon the north pole of a third magnet,* C; *if the north pole of* A *repels* C *with twice as much force as that with which the north pole of* B *placed at the same distance would repel* C, *then we should say that the strength of* A *was twice that of* B." Quite so, but suppose a person came to me with, say, a mass of metal and he asked me to tell him what its weight was, and I replied by showing him another mass of metal, and telling him that if he put the two in a spring balance he would find that one depressed the index to twice the extent that the other did, or, in other words, that one mass was twice as heavy as the other; I should like to know whether the person in question would go away perfectly satisfied with the reply, and with a clear knowledge of what the weight of the mass of metal was. Referring now more particularly to the volt, ohm, and ampère units, a student might say, "I have here a gramme weight, a metre measure, and a chronometer. There is here something tangible, which I have been accustomed to use and which expresses something definite to my mind." I can perfectly see that the weight, the length, and a period of time are merely fractional values of something fixed and definite; the metre, for instance, is the ten millionth part of the earth's circumference, the weight of one gramme is the weight of a cubic centimetre of distilled water; these explanations are perfectly clear. If, now, I want to measure the length of anything, I compare the length with that of the metre measure; if I wish to measure the weight of anything, I compare the substance with the gramme weight by means of a pair of scales or a spring balance, and I get the information I require. As regards "work," I am told that the unit is the metregramme—in other words, the work done in raising a gramme weight one meter high. A *cheval vapeur* is equally comprehensible, as it means 76,000 grammes lifted one metre high in one second. As a practical illustration, I will suppose that there is a drum around which is coiled a cord, and on which a weight of 76,000 grammes is hung; and I will suppose that the drum is connected to a pump for pumping water. Now if I so regulate the supply of water that the weight of 76,000 grammes descends through a distance of one metre in one second, I know that a power of one *cheval vapeur* is being exerted on the pump. Suppose next that instead of the pump there is a dynamo machine connected to the drum, then I know by experience that the more resistance I place in the circuit of the machine the easier it is to turn, and *vice versâ*. Consequently, I can conceive that the resistance may be so adjusted that the machine turns at such a rate that a weight of one gramme descends one centimetre in one second—in other words, a certain electrical current flowing through a certain resistance is being generated. Now, in the current thus generated there are two elements—viz., electromotive force, and resistance. The current may be generated by a high electromotive force flowing through a high resistance, or a low electromotive force flowing through a low resistance. If, however, I could fix a unit of electromotive force, I could at once fix a unit of resistance, which is directly connected with the gramme, the centimetre, and the second. But how am I to fix the electromotive force unit? Now if Professor Thompson would give an explanation somewhat in the foregoing style, he would render the matter clear.

In my Review I insisted somewhat strongly upon the advisability of making a very free use of numerical examples in making explanations. I say this as the result of practical experience and observation. For example, in making explanations of formulæ which show the effect of connecting to a battery two or three circuits of different resistances, I have commenced in the orthodox fashion by writing down the electromotive force of the battery as "E." This will not satisfy the learner, he prefers to suppose that we are dealing with something more definite than E merely, and he suggests that a 10-cell Daniell battery be the starting-point, and that we suppose the electromotive force to be called one volt per cell. This being conceded, the explanations are understood without difficulty. The fact of having the numerical value 10 before him for some reason or other, seems to clear the way and to make matters smooth to the learner. It is perhaps difficult to Professor S. Thompson to see where the difficulty of comprehension lies. But that it does exist I know full well; and, moreover, I know that the simple fact of putting numerical values to quantities in such a case as that I have indicated has smoothed matters wonderfully, although it may not be a highly scientific method of teaching. Of course there is a point at which the use of numerical values cannot explain why a formula should give a particular result, and this point is soon reached; but if the free use of numerals can enlighten a beginner, I cannot see why it should not be adopted. Certainly as regards the electrical units it would throw a great deal of light upon what is now so dark to many students. The only work that I know of in which anything like a familiar explanation of the units is given is that of Ferguson, but even here many links are left out which are necessary to complete the chain, and the inquirer, instead of being satisfied, is only tantalised.

It is perfectly true, as Professor S. Thompson says, that "few ordinary books on arithmetic go out of their way to afford detailed explanations of why the British yard is taken of a particular length, why a gallon is fixed to contain a certain number of cubic inches, &c."; it is also perfectly true, however, that almost all books on physics (such as those with which we are now concerned) give an explanation of what a gramme, a metre, or a degree, are, these being the units which have to be dealt with. With regard to "the position of a traveller who is asked by a native in the middle of Africa how cold one degree below zero is," I certainly think that if the native were of average intellect, he would be perfectly satisfied with the following explanation:—The range of temperature between boiling water and melting ice is divided into 100 parts (Centigrade scale), and one degree below zero is a temperature represented by one of these parts below the temperature of melting ice. Boiling water and melting ice are here mentioned, both of which express something definite to the intelligent native.

It is quite true that an explanation of the practical method of obtaining the units may be too intricate to explain to a beginner, but a suppositious example, somewhat of the nature I have mentioned, would give the learner some notion of the general principles of the subject, and would satisfy him.

The practical method of determining the units involves a knowledge of the horizontal intensity of the earth's magnetism, and if Professor Thompson in his "plain, unvarnished" explanations alludes to this he certainly will no more satisfy his readers if he simply states that its value is 1·788 than he would if he said that the accelerating force of gravity was 32·2, and did not explain that a weight dropped will at the end of one *second* have a velocity of 32·2 feet per *second*.

Professor Thompson further says, "we comprehend

'yards,' 'gallons,' &c., not because any one has elaborately explained their origin to us, but because we have had practice in using and applying these terms." Now this is not at all to the point; we understand the *dimensions* of a yard, a gallon, &c., from constant practice, and so we understand the *dimensions* of an ohm by constant practice, but I deny that we understand why the gallon, that is the unit capacity, is of the particular dimensions that it is. An ordinary mechanic who has been engaged in manufacturing resistance coils for, say, the past ten or fifteen years, can give a very approximate guess of the resistance in ohms of a piece of platinum wire that is brought to him, but has all this practice, I ask, given him the very least insight into the connection between an ohm, and the centimetre the gramme and the second?

H. R. KEMPE.

London, *April 8th*, 1882.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—Prof. S. P. Thompson in your last issue very courteously explains that I was in error in speaking of ampères in relation to electromotive force, as the ampère is now the most recent term used to express the strength of current, and not the electromotive force of a voltaic battery, or a dynamo-electric machine.

The learned professor refers to the fact, that whilst the last edition of his "Elementary Lessons in Electricity and Magnetism" was passing through the press, that the names of some of the Electrical Units were changed, and that the ampère is substituted for the weber. I note on page 410 of Prof. Thompson's work the following paragraphs—"The name of ampère is henceforth to be assigned to the unit of *current*, which in these lessons is called "one weber per second."

"The name of coulomb is to be given to the unit of quantity, called in these lessons 'one weber.'"

I understand that prior to the alteration in terms that the strength of a current in webers was attained by dividing the entire electromotive force in volts by the entire resistance in ohms. Thus, if the electromotive force were 1,000 volts, and the resistance 800 ohms, the current in webers was 1·25.

I note that unit of current is "one weber per second," and current of quantity "one weber." Has the latter term no relation to theory?

Are the terms weber and ampère precisely synonymous, and may one now in all instances be substituted for the other?

I observe the discussion that is taking place in relation to the evaluation of the practical ohm, and that Lord Rayleigh has slightly modified the British Association standard. The determination of the absolute ohm appears to be a problem of much difficulty. Popularly how is it arrived at?

I recognise very forcibly the accuracy of Professor Thompson's concluding remark, that "in the case of volts, ohms, ampères, and coulombs, practice in using and applying them brings home their significance, and makes us comprehend their meaning in a way that no amount of detailed explanation can ever do."

I look forward with pleasure to the publication of Professor Thompson's promised "plain, unvarnished tale, which may afford the explanations required concerning the accepted units."

I am, &c.,

T. P. BARKAS.

Newcastle-on-Tyne,
April 8th, 1882.

[The word "weber," which in the first instance was intended to signify the unit of *quantity*, had for some time previous to the Paris Congress been employed to signify the unit current. If the original meaning of the word had been adhered to, the unit current would have been "one weber per second." As, however, "quantity" was but very rarely dealt with, whilst "currents" had continually to be considered, the word "weber" was very generally (though incorrectly) used to express "current" irrespective of time, although some persons still kept to the original meaning of the word, and when they spoke of current they expressed it in "webers per second." To get rid of this double meaning which had become attached to the word was one reason why the Paris Congress abolished its use, and gave the name "coulomb" to the unit of *quantity*, and the name "ampère" to the unit of *current*, the ampère being in fact "one coulomb per second."—ED. ELEC. REV.]

THE DIP OF TELEGRAPH WIRES.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—In the older works upon telegraph construction great importance appears to have been given to the "dip" of overhead lines, the rule given in Culley "to make the supports as nearly equal in height as possible, and *the dip as large as you can*" shows this. In passing up and down a line of railway in those days the wires would rise and sink out of sight almost by the carriage window as the train travelled onwards. Now the wires appear to be pulled up almost level, and the peculiar effect produced by the dip as seen from a train in motion is no longer visible. The wires look better, and weather contacts are, I daresay, almost forgotten; but what has brought about the change? A short paper embodying the changes and improvements in overhead construction during the last ten years would greatly interest many of your readers, as well as,

Your obedient servant,

GEO. WEST.

Beechwood, Berkswell, Warwickshire.
April 11th, 1882.

[The quality of telegraph wire has vastly improved of recent years, so that its breaking strain is much greater than it used to be, and weak places are of very rare occurrence, hence it is possible to strain up the wires, without risk of breaking them, to a much less way than was possible at first. The tighter the wires are strained up the less liable are they to blow together in contact, hence the reason for the lessened dip.—ED. ELEC. REV.]

ELECTRO-MAGNETS.

To the Editor of THE ELECTRICAL REVIEW.

In your issue of March 11th, 1882, page 174, you use the term "sluggish magnet." Will you kindly explain how one magnet may be made to respond more quickly than another, and the reasons why?

Respectfully yours,

FRED. W. STONE.

Somerville, Mass., U.S.A.
March 26th, 1882.

[There are several ways of rendering an electro-magnet sluggish in its action; the simplest and most effective way is to insert a shunt between its terminals; this shunt is merely an ordinary resistance coil, and its effect is greatest when it has a resistance equal to that of the electro-magnet; thus if we take an ordinary sounder and send dots on it by an ordinary key, then it will be found that if a shunt is inserted between its terminals the dots will become dashes, in other words, the armature will be held down for a considerable time after the key contact is broken. The reason of this is that the electro-magnet in losing its magnetism induces a current in its coils, which current can circulate through the shunt, and by its reaction induce magnetism in the core of the electro-magnet; this current gradually becomes less and less, and finally ceases. Electro-magnets with long cores are more sluggish in their action than those with short cores, from the fact that the loss of magnetism has to take place along a greater length of iron, which takes time. A very sluggish action may be obtained by making each of the cores of a thin iron tube and then filling up the latter with a number of sheet iron discs of the same diameter as the inside of the tube.—ED. ELEC. REV.]

THE DEVELOPMENT OF A NEW TELEPHONIC SYSTEM.

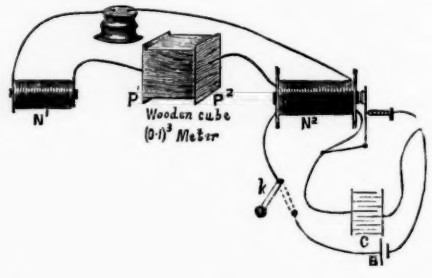
To the Editor of THE ELECTRICAL REVIEW.

SIR,—In your last report on the general meeting of the Society of Telegraph Engineers and of Electricians I found a report of a paper read by Professor A. E. Dolbear, before the said Society, on "The Development of a New

Telephonic System," which paper reminds me of an "improvisato," but interesting, experiment made last year at the Paris Electrical Exhibition.

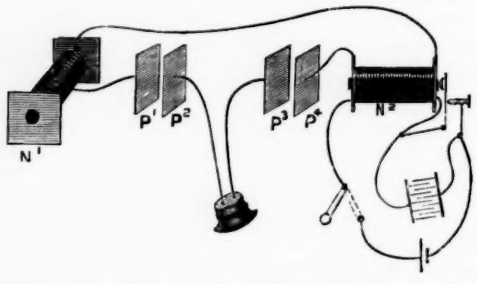
Before entering on the subject, I wish to say that in writing this letter after Prof. Dolbear's paper, I am not moved to claim priority (so conspicuous amongst speculators), nor that of throwing any doubt in regarding him as the first who brought the subject before the public.

Whilst visiting the various exhibits on the upper galleries, I came to that of M. L. Maiche et Cie Société de l'Electrophone. I found in this show a multiphone transmitter, which could transmit on the same wire the articulate speech of a person, the melodies of a musical box, of a piano, and also that of a brass instrument. But the one which attracted my attention was that of two inductoriums, disposed horizontally on a bench one meter apart one from the other. The primary of No. 2 coil (as shown in the following diagram) was worked by a few Bunsen's, also having a suitable condenser, as in the ordinary induction coils.



The secondary was connected through a telephone of high resistance to one terminal of the coil No. 1. No. 1 coil had only one coil, as the primary in this case would have been obviously detractory rather than a help to the secondary, unless it was an open circuit.

Both ends of the coils were connected with a copper plate, 12 centimetres square, placed parallel to one another, and having a wooden cube interposed. On working No. 2, an induced current was set up alternatively in No. 1 coil in the same direction as that of the secondary of No. 2 coil, therefore producing a sound into the telephone, which sound varied in intensity with the number of makes and breaks in a given time of the primary or battery circuit. The idea of this experiment, I believe, was simply for showing that his telephone was so sensitive as to work through a high resistance, as represented by the wooden cube. By permission, I was allowed to make an alteration in the connections, as shown in the following diagram:—



After having done so we worked No. 2 coil as before, and still sound, though rather feeble, could be distinctly heard. By observing this latter experiment it will be seen the effect or action is purely statical, as the effect of magnetic induction is totally neutralised by placing No. 1 coil and the telephone in an equipotential position relative to the inductor No. 2, whereas in the first experiment the effects were more magnetical than statical.

I must confess that we were both pleased at the unexpected success of this latter experiment. Now, it is not difficult to see that it is quite possible to produce sound in a telephone by merely reversing the electrical condition at its ends through induction by a neighbouring electrified body, and improving the effect by substituting a suitable condenser at each end of the telephonic circuit. Further, we dispensed with No. 1 coil and also plate P_1, and separated the plates, P_3, P_4, and sound, though still feebler, was not totally extinct. By this experiment it shows that by mere electrical disquilibration of the neutral state of the plates attached at the ends of a telephonic line or circuit is enough to produce a slight electrical wave along the wire, therefore disturbing also the magnetical state of the telephone, which result is a tick. As it is well known the pitch of the sound is proportional to the number of vibrations in a given time, it follows that if a series of alternates are made by induction on the plates, P_2, P_3, in a given time, the result is a series of ticks or sounds, therefore confirming Professor Dolbear's statement.

Hoping you will find a space for the insertion of this letter in you valuable periodical, I thank you beforehand.

I am, Sir, your obedient servant,

H. CONTI.

London, *April 11th*, 1882.

To the Editor of THE ELECTRICAL REVIEW.

DEAR SIR,—By affording me information of the queries on the other side you would greatly oblige,

Yours truly,

CHAS. HAYLETON.

Gosvenor Road, Belfast.
April 1st, 1882.

1st. Is the School of Submarine Telegraphy and Electric Light Company, situated at Princes Street, Hanover Square, W., all it professes to be in its prospectus?

2nd. After having passed through this school, would it be a suitable line of life for a young man, of 30 years of age, who has a liking for the business?

3rd. Is there any other school of the kind in England but the one?

4th. If so, where?

5th. Is there a demand for skilled electricians, or is there likely to be?

[Perhaps some of our readers can speak with experience on our correspondent's first query. Referring to his second and fifth questions, an electrician's life is certainly a suitable one, and there is now and will be a great demand for *skilled* men. We cannot recommend better instruction on this subject than that to be obtained at the City and Guilds of London Technical College, under the direction of Professor W. E. Ayrton; or our correspondent might with advantage enter the College of Science and Arts at Glasgow, the Principal, Professor Jamieson, being a well-known electrician.—ED. ELEC. REV.]

M. BOUCHER DE BOUCHERVILLE.—We will consider your suggestion and if possible will act upon it. We are obliged to you for bringing it to our notice.—ED. ELEC. REV.

NOTES.

ACTION OF TELEPHONIC CURRENTS UPON THE GALVANOMETER.—By M. de Chardonnet.—If in a telephonic circuit we substitute for the receiver a very sensitive galvanometer, and if we act upon the transmitter by means of a tuning-fork, an organ-pipe, or the voice, we observe no deviation as long as the sound preserves the same intensity, but as soon as it increases or diminishes the needle deviates. This movement changes its direction according as the amplitude of the vibrations of the sounding body increases or decreases. The effect is most marked when the transmitter is affected by a sound of short duration, such as a detonation or by a body struck slightly upon the vibrating plate. In the latter case, the needle of the galvanometer leaps like the second hand of a clock. The experiment succeeds well if the sounding body is approached to or withdrawn from the transmitter. These deviations appear much more distinctly when a microphone-transmitter is used, such as that of Ader, but they are visible with every kind of telephone.

The explanation appears simple. As long as the oscillations of the vibrating plate retain the same amplitude, and consequently the same speed, the induced currents at each complete vibration compensate their action upon the galvanometer alternately in both directions, whether they proceed from an electro-magnet or from a microphone. But if the oscillations tend, *e.g.*, towards zero, each odd semi-oscillation has a greater amplitude than the even semi-oscillation following, and the induced currents, direct and inverse, no longer set in motion, two and two, the same quantity of electricity. The residues of the same direction in each complete oscillation accumulate so as to deflect the needle, and the deflection is the greater as the decrease is the more rapid.—*Comptes Rendus.*

Telephonic Indicator of the Torsion and the Speed of Revolution of the Moving Axle of Machines.—By M. C. Resio.—In a memoir presented to the Academy of Sciences, March 15th, 1880, I gave the description of a mechanical arrangement which if fitted to the moving shaft of machines measured its torsion by means of the telephone. But for this procedure two persons were required—one at the telephone, who would have to take his post at a considerable distance from the machine, the noise of which would hinder him from hearing the sounds of the telephone; the other very near to the shafting, who would have to displace one of the coils until the sounds of the telephone were extinguished, and measure the displacement required for this purpose in order to calculate the torsion. The process besides was applicable only to machines whose moving axle is of considerable length.

I have devised a new arrangement which can be applied to any machine whatever by a suitable modification of the transmitter, and in which a single observer placed at any distance from the machine may measure the torsion and the angular speed by the moving shaft, and consequently the work of the machine. The apparatus is composed of two parts, connected together by the electric current. One part applied to the shaft forms the transmitter, whilst the other, which may be placed anywhere, is the receiver. The principle on which it is based is as follows:—If in a circuit containing a battery and a current interrupter capable of giving a sound there are two identical coils, A, A′, arranged in tension, the one turned to the right and the other to the left, the induction currents, excited in two other (induced) coils, B, B′, alike in all points and connected in tension in a circuit containing a telephone, destroy each other, and consequently the telephone will be mute if they are equally distant from the inducing coils, A, A′, but it will give a sound if the distances are unequal.

To have an idea of the transmitter, suppose on the moving shaft of the machine a rigid stem, 1·50 to 2 m. in length, and fixed in a direction parallel to the shaft, to which it is fixed by one end, whilst at its free extremity it supports the induction coil, A. If we place on the shaft opposite this coil an induced coil, B, at a certain distance, and in such a manner that their axle may be in the same right line, it is evident from the torsion of the shaft in that part of its length occupied by the rigid stem the inducing coil will approach to or depart from the induced coil, according to the direction of the rotation, and that the distance, *d*, of the coils will have a relation to the motor effort—a relation which must be determined experimentally.

The receiver is composed of two coils, A′, B′, identical with those of the transmitter, placed in the same manner and at the same distance. One of them, A′, can slide along a graduated scale, approaching or receding from the fixed coil, B′.

Let the inducing coils, A, A′, of the transmitter and the receiver be arranged in tension in a circuit containing a battery, and an interrupter formed by a toothed wheel insulated upon the motor shafting. At each revolution of the shaft we shall have in the circuit a number of currents equal to the number of teeth in the wheel. The induced coils, B, B′, connected in tension, being introduced in another circuit containing a telephone, the latter will emit a very loud sound if the exciting currents are turned in the same direction in the induced circuit. But since the inducing coils are so disposed as to excite contrary currents in the induced coils, the telephone will be mute if the distance of the coils of the receiver is equal to the distance of the coils of the transmitter. We proceed, then, as follows, to determine the effort transmitted to the axle of the machine.

Move the coil, A′, of the receiver until the telephone becomes mute; then the distance of the coils of the receiver will be equal to that of the coils of the transmitter. We know then the motive effort, since we have previously determined this effort, F, corresponding to different distances of the coils, and may write it upon the graduated scale. If L is the arm of the lever of the ascertained effort the work of the machine at each turn of the shaft $= 2\pi LF$.

But to calculate the work of the machine in a unit of time we must know the number of revolutions of the shaft per second. For this purpose we place at the side of the telephone of the receiver a tuning-fork, the branches of which support two equal masses which may be displaced: for each position of the masses there is inscribed upon the branches the number of vibrations corresponding. It is then easy to determine the number of revolutions of the motor axle in a unit of time. We listen to the telephone, and at the same time to the tuning-fork, and we move the masses until it is in harmony with the telephone. Let N be the number of vibrations of the tuning-fork; the number *n* of the teeth of the interrupter-wheel being known, the number of revolutions of the motor shaft per second will be $\frac{N}{n}$. We have then the elements of the work which is given by the formula

$$T = 2\pi LF \frac{N}{n}$$

If the shaft of the machine is not long enough the transmitter must be modified. When the movement is transmitted to the shaft by means of a driving belt it may be arranged as follows:—A loose pulley is connected by springs to a pulley fixed upon the shaft; to this is applied the inducing coil, A, and to this again the induced coil, B, and they are placed opposite each other at a suitable distance. In other respects the above arrangement is preserved, and the elements of the work are determined in the same manner.

It has been supposed that the distances of the coils of the receiver are equal to that of the coils of the transmitter when the telephone is mute. It may happen that this is not the case; still, since at each effort applied to the motor shaft we have determined the distance for which the telephone is silent, the number written upon the scale will always give the effort transmitted. It has also been assumed that the torsion is constant during the experiment. It may, however, vary periodically at each revolution of the axle. In this case the position of the telephone when emitting a sound of minimum intensity will give the *mean* effort.—*Comptes Rendus.*

The Electric Light in the British Museum.—A notice, signed by Mr. Bond, chief librarian, has been posted in the British Museum Library, announcing that in the reading-room the electric light would be continued during the month, so that readers can remain till eight p.m.

The Electric Light in South Kensington Museum.—If, as has been stated, the use of the electric light at the South Kensington Museum has resulted in a saving, as compared with the cost of gas, at the rate of over £400 per annum, shareholders in the gas companies may well begin to ask themselves whether their stocks are worth the prices at which they are at present quoted. We doubt the fact.—*The Citizen.*

Siemens' System of Electric Lighting.—The following letter was read at the meeting of the Commission of Sewers last week, in reference to the lighting of the City by the electric light:—

12, Queen Anne's Gate, Westminster,
March 31st, 1882.

Gentlemen,—We notice in the *Times* of to-day a statement made by the chairman of your commission to the effect that with reference to the three electric lighting systems now being tried experimentally in the City, Siemens' system was nearly four times the cost of gas.

Such a statement, if remaining uncorrected, would tend to leave a very erroneous impression upon the public mind regarding the cost of electric light as compared with gas. When a year ago we were called upon to instal the electric light in the third district set aside for that purpose, we regarded the matter as an interesting experiment, which was intended to lead to some definite arrangement on the expiration of the year. We therefore took every care to give a permanent character to our apparatus, the well-insulated wires being supplied of such a capacity as would provide for an increased demand of lighting power, and being laid in pipes securely imbedded below the paving. The result has been satisfactory in so far that the arrangements have, with the exception perhaps of the occasional failure of a single light, fulfilled their purpose without stoppages or interruption. Under these circumstances we were not disposed to extend the period of trial except on such terms as would, notwithstanding the unfavourable circumstances of the limited application, leave a reasonable margin of profit. It would not be difficult to show that in hiring a warehouse in the most crowded portion of the City of London, and in appointing a special staff of superintendents for the working of the limited number of lights spread over a single line, the expenses are incomparably greater than would be the case if permanent engines were laid down, and instead of a single line of lights, the illumination was extended to a compact district including a system of private lighting, to which it is well known the gas companies look chiefly for their profits. The statement made by your chairman would lead an uninitiated person to believe that our electric light was four times dearer than gaslight of the same brilliancy, whereas he himself states in his further remarks, that where gaslight of the improved description is brought into competition with the electric lighting, its cost is increased fourfold. If gas-works had to be established under the same unfavourable condition of being placed in the City, subject to a short notice to quit, and with the practical prohibition to supply private consumers, the balance of expense would be largely in favour of the electric light notwithstanding our increased tender. At the same time we wish to repeat here an admission that we have often made, that gaslight is capable of being developed side by side with electrical illumination. In proof that our system of electric lighting is not intrinsically dearer than other systems, we may mention that our works have difficulty in supplying the public demand for our class of apparatus, and that we have taken contracts for the lighting of establishments such as the British Museum and the Savoy Theatre, and of the town of Godalming, at prices not materially exceeding the cost of gas-lighting, and certainly not exceeding it if reasonable allowance be made for the greatly increased illumination furnished. Other electric light companies may possess advantages as regards the City of London, in being able to effect the illumination from permanently established works in a cheaper neighbourhood, or they may be willing to continue the experimental period at a loss to themselves. All we contend for is that the chairman's general remark that the Siemens' lights were, *per se*, four times more expensive than gaslight would be misleading, and should, we submit, be set right on a fitting occasion.—Your most obedient servant, C. W. SIEMENS.

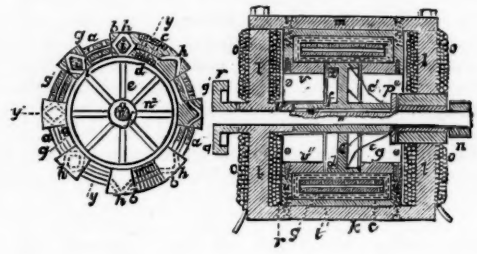
The chairman said, when he referred to this matter on a previous occasion, he quoted from the engineer's report, where it was stated that in District No. 1 the cost of lighting by gas for twelve months was £690, and the cost of electric lighting by the Brush system was £660. In District No. 2 the cost was £700 by gas-lighting, and £1,460 by electric lighting (Lontin system); and in District No. 3 the cost was £612 by gas-lighting, and £2,270 by electric lighting (Siemens' system). The new contract sent in by Messrs. Siemens was for £3,600, nearly six times as much as gas. The engineer also said: "Dismissing the expense of maintaining the disused gas lamps, the cost of the electric lighting in District No. 1 (Brush) would be about the same as that of gas; in No. 2 (Lontin) about twice the cost of gas; and in No. 3 (Siemens) $3\frac{3}{4}$ times as much as gas." On the motion of Mr. Innes, seconded by Mr. J. S. Scott, it was referred to the Streets Committee to consider the general question of lighting shops and warehouses by electricity.

EDISON'S ELECTRIC LIGHT.—Holborn, from Newgate Street to Holborn Circus, has been lighted by the Edison incandescent lights. Two are placed in each lamp, with the gas kept burning between them. There are about 160 of the ordinary small bulbs, and four large ones at the entrances to the London, Chatham, and Dover Railway Station, of about fifty candle illuminating power, which give a very brilliant light.

DYNAMO-ELECTRIC MACHINE.—Patent No. 254,050. Filed in the United States of America Patent Office December 3rd, 1881.—By W. E. Sawyer.

Brief.—The pole-pieces of the field-magnets nearly surround the cylindrical armature within and without. The armature is cast in one piece, and has air-passages extending through those portions upon which the wire is wound, and having external openings in the polar extensions.

Claim.—1. A ring-armature on the Pacinotti principle, composed of one piece of metal, and having air-passages



extending through the parts on which the induced conductor is wound and out at the external periphery of the polar projections, substantially as and for the purpose set forth.

2. A ring-armature on the Pacinotti principle, composed of one piece of metal, and having air-passages extending through the parts on which the induced conductor is wound and out at the external and internal peripheries of the polar projections, substantially as and for the purpose set forth.

3. A ring-armature core, composed of the parts, *a a*, and polar extensions, *b*, having air-passages, *g g*, and openings, *h h*, in combination with the conductor, *c*, wound on the parts, *a a*, substantially as set forth.

4. A ring-armature core having the polar projections, *b b*, depressions, *a a*, for the reception of the conductor, *c*, the air-passage, *g g*, openings, *h h*, in the outside periphery and openings, *i i*, in the inside periphery of the polar projections, *b b*, substantially as set forth.

5. The armature composed of a paramagnetic ring with polar projections, *b b*, and having air-passages, as described, and an insulated electric conductor wound thereon between the polar projections, in combination with the diamagnetic wheel, *d e f*, substantially as set forth.

6. A frame for dynamo-electric machines, composed of a base-plate, *k*, and side pieces, *l l*, having bearing, l^1 l^2, in their centre for the armature-shaft, *n*, and forming cores for the coils of the field magnets, *o o*, substantially as described.

7. In combination with the frame, *k l l m*, the grooved curved poles, *s s'*, substantially as set forth.

8. In combination, the frame, *k l l m*, poles, *s* s^1, having side flanges, *u* u^1, and the curved plates, *v* v^1, substantially as described.

9. In a dynamo-electric machine, the ring-armature, *a b c*, diamagnetic wheel, *d e f*, poles, *s* s^1, frame, *k l l m*, field-armature coils, *o o*, on the side pieces, *l l*, and bearings for the armature shaft in the centre thereof, substantially as set forth.

10. A ring-armature core composed of the parts, *a a*, and polar extensions, *b*, having air-passages, *g g*, and openings, *h h*, in combination with the deflectors, *i i*, substantially as set forth.

THE EASTERN ELECTRIC LIGHT AND POWER COMPANY.—The experimental display of the Eastern Electric Light and Power Company's electric lights of the Brush system will be brought to a close at the end of the present month, as the experiment may be considered conclusive and exhaustive. The lights have been tested under every adversity and stood well. The light had to labour under the disadvantage of being at an improper elevation, whereas at a height of 30 feet the lamps would have had a more powerful effect and better chance of reflecting their light downward, aided by reflectors, which the limited height of the poles did not admit of being put up. The company's representative, Chev. E. Rosenbusch, has, we are informed, handed in a tender for lighting Strada Reale, the whole of the grand harbour, and any other part of Valletta, and we trust soon to see again the Brush light shine, and with improved chances of success under a permanent installation, with underground wires in earthenware tubes, on elegant iron lamp-posts of 30 feet high, alternate lights on the sides of the road, and thus equipped, we wish the Brush light a

speedy return to our streets and harbour. The domestic wants will be very shortly supplied by the Lane-Fox incandescent lamps, which will be fed by stored electricity from accumulators charged by the Brush dynamo machine and admitting of being sent to the various parts of the island.—*Malta Standard*, March 30, 1882.

The Electric Light in New York.—According to the *Operator*, the Brush Electric Light Company continues to light the streets in this city in the most satisfactory manner, and is rapidly completing its pole lines to different parts of the city. The Edison Company is vigorously at work on its gigantic undertaking of an underground system and central stations for distributing electricity, and promises, in the end, to abolish the use of gas. Mr. G. W. Hebberd, President of the United States Electric Light Company, is systematically reorganising that company. Maxim's lamp and Weston's generator are used by this company. Some of its lights have recently been put up at the Grand Street station of the Third Avenue "L" road.

Estimates for Electric Lighting in New York.—The *Operator* says that "among the bids for lighting the city opened March 27th were two from electric light companies. The Brush Company offered to light a certain territory, requiring about 272 electric 'avenue' lamps, at 70 cents per lamp; also at High Bridge at 1 dol. per night. The United States Company also put in a bid to light a smaller territory at 70 cents each lamp per night. The lowest bid of the gas companies was 17 dols. 50 cents per lamp for the year."

Edison's Electric Railway.—We extract the following note from the *New York Review of the Telegraph and Telephone*:—"Several miles of Mr. Edison's electric railway at Menlo Park are now completed, and a few days ago the pupils of Professor A. E. Sloan's school, of Bergen Point, N. J., about thirty in number, were carried over this road by electricity at the rate of over twenty miles per hour. At the experiments in Berlin last year, on nine miles of the Siemens road, the speed attained was only about ten miles per hour. Mr. Edison's track is like that of any ordinary railroad, involving curves, grades (one over thirty feet to the mile), with the various obstacles of ravines, streams, and rocks. The car resembles our modern horse-car. The electricity is communicated from the generators, some 300 yards away, by two heavy wires, one connecting with each track. The tracks are insulated by covering the ends of the ties with a non-conducting compound. The wheels take up the electricity from the tracks and communicate with the dynamo-electric machine and gearing in the locomotive. Thus is given to the train a noiseless, rapid, pleasant motion, unattended with smoke, cinders, and clatter."

The Dangers of Electric Light Currents of High Tension.—We clip the following from the *Electrician*, of America:—"On March 11th a workman at the Cleveland, O., rolling mill was instantly killed by an electric shock from a Brush dynamo machine. He had been repeatedly warned not to touch the machinery. From his position when found it seemed probable that he had touched the brushes of the machine."

Electrical Exhibition at Munich.—We believe that experiments on a large and exhaustive scale are to be carried out in the Crystal Palace at Munich, on all matters connected with electric lighting, transmission of power, &c. The undertaking promises to be of great practical value, and is to last from the 16th September to the 18th October. The financial arrangements are to be guaranteed by the state and by private subscriptions.

Electric Light Exhibition in Scotland.—On Thursday evening, April 6th, the Oban Electrical Exhibition was inaugurated in Argyllshire Hall. Mr. Andrew Jamieson, the Principal of the Glasgow College of Science and Arts, lectured then and also on the following evening, the second lecture being chiefly devoted to the Joel lamp.

The Sellon-Volckmar Accumulator.—In consequence of the many conflicting rumours respecting the validity of the patents for this secondary battery, and the allegations made by M. Phillippart, the President of "La Société Force et la Lumière," against Mr. Volckmar, we do not think it advisable to enter into this matter at length just now as we had previously intended. We may, however, mention one point of interest connected with the structural arrangements of the new cells. Should any lead trees tend to form across from plate to plate, they may be easily swept away by passing a thin piece of wood or other material between the plates.

The United States Underground Cable Company has been organised under the general laws of the State of New York, with a capital of 600,000 dols., which is divided into 6,000 shares, with a par value of 100 dols. per share. This company has contracted with the Société Anonyme des Cables Electriques, of Paris, France, for the purchase of the Berthoud-Borel patents for the United States, and it proposes to manufacture and lay underground electric cables, both for telegraphic purposes and lighting, and for telephonic purposes. The Société Anonyme des Cables Electriques will manufacture and ship full and complete sets of machinery for the purpose of putting into practical operation the Berthoud-Borel system in the United States, and will send skilled mechanics to explain and superintend the working of the same.

College of Electrical Engineering.—It is stated that the Hammond Electric Light Company have started an electrical engineering college, in order to provide the thorough scientific and practical training necessary to young men of good education who wish to become electrical engineers.

The Greitseil-Valentia Cable.—The steamship *Scotia*, belonging to the Telegraph Construction and Maintenance Company, came up the river Thames on Tuesday evening, and is now lying off the company's wharf. She has just returned from the completion of the above cable.

Mexican Cables Extension.—The ss. *G. E. Wood*, chartered by the India-rubber, Gutta-percha and Telegraph Works Co. to assist their ss. *International* in extending the Tampico-Brownsville section of the Mexican Telegraph Co.'s cables to Galveston, U.S., arrived off the Silvertown Works on Saturday, the 8th inst. The *G. E. Wood* is a steamer of 1,084 tons gross and 98 horse-power nom. She will be fitted with an iron cable-tank and the necessary gear and machinery for laying the cable she has to carry out to Mexico. Mr. H. Benest goes out in charge of the *G. E. Wood*, and will probably leave the river by the 25th inst. The ss. *International*, with the greater part of the cable on board, will leave before the end of the month. Capt. W. F. Wardroper takes charge until arrival at Kingston, Jamaica, where Messrs. Theophilus Smith and J. Rymer Jones join the *International*. Mr. Theo. Smith then takes charge of the expedition.

NEW COMPANY REGISTERED.

Union Electric Light and Power Company, Limited.—Capital £25,000 in £100 shares. Objects: To produce and supply electric light and power, and for such purposes to carry out an agreement of the 9th ult. between James Fyfe and Dillwyn Parrish for the purchase of certain inventions and letters patents. Signatories (with one share each): Dillwyn Parrish and Alfred Parrish, of 2 Copthall Buildings; G. Richardson, 3, Lombard Court; J. Goddard, Beckenham; J. Goddard, Junr., 81, Gracechurch Street; J. W. Hodding, 9, Drapers' Gardens; Patrick Buchan, 10, Angel Court; and Andrew Hutton, 2, Copthall Buildings. The signatories are to nominate the first directors; qualification, £1,000 (nominal) in shares or stock; remuneration, £1,500 per annum. Registered 5th inst. by Walter Webb and Co., 23, Queen Victoria Street, E.C.

NEW PATENTS—1882.

1626. "Electric light and power apparatus." J. MUNRO. Dated April 4.

1640. "An improved dynamo-electric machine." R. KENNEDY. Dated April 4.

1642. "Incandescent electric lamps." W. H. AKESTER. Dated April 5.

1647. "Manufacture of incandescent electric lamps." ST. G. L. FOX. Dated April 5.

1649. "Improvements in underground conduits for electric wires, and in the method of laying the wires therein." A. J. BOULT. (Communicated by J. D. Thomas.) Dated April 5.

1663. "Improvements in the arrangement of circuits, and in apparatus to facilitate communication by telephone." F. D. A. GOOLD. Dated April 6.

1670. "Incandescent electric lamps." J. JAMESON. Dated April 6.

1684. "Telephonic instruments." A. E. DOLBEAR. Dated April 6.

1689. "Electric lamps." G. S. YOUNG and R. J. HATTON. Dated April 6.

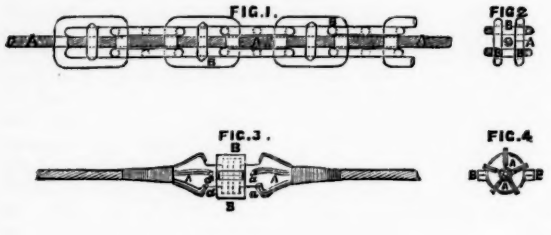
1692. "Dynamo-electric or magneto-electric machines." D. T. PIOT. Dated April 6.

1698. "Manufacture of incandescent electric lamps." Hon. R. BROUGHAM and F. A. ORMISTON. Dated April 8.

1713. "Electric lamps." J. BROCKIE. Dated April 11.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

3463. "Chain for protecting submarine telegraphs, &c." FRANCIS ROBERT LUCAS. Dated August 10. 6d. This invention consists of a double link chain with a submarine telegraph cable drawn through it between the links in such a manner that the telegraph cable passes straight through the centre of the chain cable, and is protected by the links which inclose it from dragging and chafing on the bottom with the motion of lightships in tides and currents: it may also be used for protecting cables from ships' anchors, for crossing rivers, or on the coast where great strength is required. Fig. 1 is a longitudinal elevation of the chain cable with the telegraph cable, A, A, running through its centre. The chain, B, B, is made double, each link being studded, and in order to prevent the links coming together and gripping the cable, each corner of every link is recessed to receive the next link. Fig. 2 is a cross sectional view of same. Fig. 3 is the



revolving joint on the telegraph cable. It consists principally of two hollow flanged castings, A, A (made preferably of malleable iron or steel), into which the ends of the cable are passed, and to which they are secured by passing the outside or covering wires of the cable through holes, *a*, *a*, in the castings, bending them back until they lie flat on the cable, and serving round all with wire. The flanges on the outer ends of the castings are embraced by a cupped ring, B, put on in two pieces and bolted together. This while allowing the castings perfect freedom of motion in every direction prevents their coming apart more than a certain fixed distance. Fig. 4 is an end view of the same. Fig. 5 is an enlarged sectional view of the revolving joint, showing the arrangements for insuring electrical contact and insulation between the two ends of the conductor. *c*, *c*, is the gutta-percha core which passes through the centre of a rod of vulcanite, D, and is made watertight in the same by the stuffing box and gland, E, E. The rod, D, has a square shoulder fitting loosely in a square recess in the casting, A. The rod, D, projects sufficiently to allow it to pass through a stuffing box and gland, F, F, into the vulcanite cylinder, G, G. The cylinder, G, G, is secured in the casting, A, by the set screw, *g*. The opposite end of the core, *c*, *c*, passes through the bottom of the cylinder, G, G, and is made watertight by the stuffing box and gland, H, H. The two ends of the conductor are kept in contact by means of a loose spring, I, rubbing on contact plates, K, K, which are soldered one on each end of the conductors.

3472. "Dynamo-electric machines." E. J. HARLING and EMIL HARTMANN. Dated August 11. 8d. Relates, first, to improvements in the construction of that class of dynamo-electric machines in which a rotating ring armature is brought into close proximity with the field being to means of projecting pieces, the object of such improvements magnets by obtain a proper distribution of the magnetism induced, and to insure the magnetic polarisation of the same in the proper direction throughout the armature; secondly, to improvements in the construction and arrangement of the field magnets of the machine, whereby the magnetisation and de-magnetisation of the parts of the armature are effected in a more effectual manner than is the case in similar machines as ordinarily constructed; thirdly, to the construction and arrangement of a regulator by means whereof the currents of electricity generated are always maintained at the same strength, any fluctuation being counteracted by means of the said regulator; and fourthly, to the arrangement and electrical connection of the coils of the rotating armatures of dynamo-electric machines.

3483. "Electric conductors, &c." E. G. BREWER. (A communication from abroad by Thomas Alva Edison.) Dated August 11. 6d. Relates chiefly to the segmental conductors described in the number of the journal for Nov. 5th, 1881.

3509. "Electrical interruptors." PERCY ULLATHORNE. Dated Aug. 12. 6d. Relates to electrical current interruptors, rheotomes, or contact-breakers. In its first form the apparatus consists essentially of three stretched metal strings or wires nearly parallel to each other, but not in the same plane. The contact wire is platinised at its contact point, and must be insulated from the other two which are suitably attached to the ends of a soft iron armature lying in the plane between the contact wire and the two external wires, and the part thereof which makes contact with the contact wire is platinised. The wires are stretched over bridges which may be three or more in number, and the armature may bisect the vibrating portion of each of the wires to which it is attached, and these four vibrating sections may be equally stretched, and of equal length, density, and diameter. The contact wire is stretched upon bridges, one of which may with advantage be placed very near the armature, and may be separated from the others. An electro-magnet is placed on that side of the armature which is farthest from the contact wire. Supposing the current to enter the coil of the electro-magnet, it passes to the extremity or extremities of the armature wire or wires, and into the armature; from the armature it passes to the contact wire, and makes its exit from one or both extremities of the vibrating portion of the contact wire which is not furthest from the armature.

3538. "Registering by electr icity the number of picks woven per inch in looms." JAMES POBEITT. Dated August 15. 6d. Consists in a new means or method of indicating at some distance from the place in which looms are working, say, in the office or warehouse, the number of picks which the looms are making per inch, so that the employé or other person can ascertain without visiting the interior of the works whether the weaver is placing in the material the proper number of picks required per inch of the material woven. For this purpose there is attached to the inner side of the breast beam of a loom an instrument or apparatus actuated at each beat up of the slay or other going part of the loom in such manner that the result of each "beat up" shall be registered on an indicator in the office or warehouse. The instrument is connected by electric wires to an indicator.

3539. "Electrical apparatus." W. R. LAKE. (A communication from abroad by C. Williams, junior, and F. W. Harrington, both of America.) Dated August 15. 8d. Relates to improvements in electrical apparatus chiefly designed for telegraphic and telephonic purposes, and comprises various novel features. The first part of the invention has special reference to magneto generators, and has for its object to automatically put the generator into and out of a circuit when required to send a magnetic current over the line for signalling or other purposes. The invention further relates to that class of telephone switch boards in which the line circuit strips are provided with springs adapted to bear with a yielding pressure against plugs inserted through perforations in the insulated connecting strips, which cross the board at right angles with the line circuit strips. Heretofore in this class of switch boards the springs of the line circuit strips have been so arranged that each plug receives the pressure of but one spring directed against one side of the plug. This part of the invention has for its object to so arrange said springs that each plug shall receive the pressure of two springs bearing on opposite sides, so as to give a more r eliable contact.

3711. "Electric lamps." F. H. F. ENGEL (A communication from Carl Heinrich Florenz Müller, of Hamburg.) Dated Aug. 25. 2d. Relates to the construction of electric lamps, with which the light is produced inside a vacuum glass cylinder, and consists in combining the metallic arms or conductors carrying the carbon inside the glass, with the outer wires coming from the battery or dynamo-electric engine, by means of strips of fine sheet platina, instead of by platina wires as has formerly been done. (*Provisional only.*)

3731. "Apparatus for transmitting and receiving audible signals by means of electricity." A. F. ST. GEORGE. Dated August 26. 4d. Relates to apparatus used for the purpose of acoustical electric telegraphy or telephony, and it has for its objects novel methods of construction and arrangement of such apparatus, so that it is more simple and effective, and at the same time cheaper in manufacture and working than apparatus for such purpose as heretofore ordinarily constructed and used. (*Provisional only.*)

CITY NOTES.

Old Broad Street.

THE ORIENTAL TELEPHONE COMPANY, LIMITED.

The report of the directors, to be presented at the annual general meeting of the company to be held on Wednesday, the 19th instant, contains also a statement of accounts for the period betwixt the registration of the company on the 4th of February and 31st of December, 1881. The report states that the attention of the directors during this interval has necessarily been devoted to consolidating their concessions, and to constructing the exchanges from which the company looks forward to obtaining its revenue, and the directors are glad to state that, considering the distant fields of the company's operations, and the various negotiations which had to be undertaken with governments, municipalities, and others, the progress has been on the whole satisfactory, and promises to be still more so. It will be perceived that the outlay during the period under review has been entirely on capital account. The company has from various sources, chiefly interest on money, earned the gross revenue of £1,377 10s., which the directors propose to use in reduction of capital expenditure. The Alexandria Exchange was opened in August last, and has now about 80 subscribers, with a gross return approximating £1,800 per annum. In Cairo the exchange is partially opened, and the directors hope very shortly to hear that the work is complete. They anticipate that there will be 50 subscribers, and a gross revenue of about £1,000 per annum, to begin with. An application has been made to the Egyptian Government for the right to construct telephone exchanges in other towns in Egypt, which the directors hope will be granted, and they look for a steady and continuous improvement in the revenue of the Alexandria and Cairo Exchanges. Considerable delay occurred before the directors secured permission from the Indian Government to commence operations, but the Calcutta, Madras, and Bombay Exchanges were declared open on the 28th January, 1882, by the Honourable Major Baring, Finance Minister of the Indian Government. According to the latest advices before the directors, there were 92 subscribers in Calcutta, 51 in Bombay, and 25 in Madras, and the local agents advise that a steady increase in numbers is certain. In Rangoon, Ceylon, and Kurrachee, arrangements have been made for opening exchanges shortly, and measures are being taken to ascertain in what towns the company can further successfully operate in India. In Hong Kong permission has recently been obtained from the local government to establish an exchange. Already a commencement has been made, and material is on the way to make the necessary additions. In Shanghai the company has also obtained permission from the local councils to form an exchange, and several subscribers have already been put in communication with each other. The Honolulu Exchange by last advices had 180 subscribers, with a gross revenue of about 11,000 dols.; expenses being about 5,000 dols. It will be in the recollection of the shareholders that at an extraordinary general meeting, held on the 28th December, 1881, a resolution was passed formally approving an agreement entered into with the vendors involving a considerable reduction in the original purchase money. The formal deeds were not executed at the close of last year, and hence no entry of payment to the vendors appears in the accounts. The deeds have since been executed, and the purchase money in cash and shares handed over. Mr. Dillwyn Parrish retired in the course of 1881. The directors elected Mr. James Pender in his stead. In accordance with the prospectus, Messrs. Alexander Graham Bell, Thomas Alva Edison, John P. Bigelow, W. W. Cargill, the Honourable Gardiner G. Hubbard, and Colonel Gouraud, now join the Board, the purchase having been completed. According to the terms of the articles no change in the constitution of the board needs to be made this year. The directors in terms of Clause 89 of the company's articles appointed the firm of Messrs. Deloitte Dever, Griffiths and Co., auditors of the company. They now retire, but offer themselves to the shareholders for re-election.

THE EASTERN EXTENSION, AUSTRALASIA, AND CHINA TELEGRAPH COMPANY, LIMITED.

The report of the directors for the six months ended 31st December, 1881, to be presented at the seventeenth ordinary general meeting of the company, to be held at the City Terminus Hotel, on Wednesday, April 19th, 1882, states that the gross receipts, including a sum of £27,350 for Government subsidies, have amounted during the half-year to £205,963 0s. 4d., against £193,435 9s. 6d. for the corresponding period of 1880, showing an increase of £12,527 10s. 10d. The working and other expenses (including £18,828 3s. 5d. for cost of repair of cables and expenses of ships) absorb £51,643 9s. 8d., against £56,730 5s. 3d. for the corresponding half-year, leaving a balance of £154,319 10s. 8d. From this is deducted £1,390 5s. 8d. for income tax, and £41,595 for interest on debentures and contribution to sinking funds, leaving £111,334 5s. as the net profit for the half-year, which, with the £34,830 10s. 10d. brought forward from the previous half-year, makes a total of £146,164 15s. 10d. to be dealt with. Against this balance the directors have charged £34,363 11s. 5d. on account of the new Singapore-Batavia cable referred to below. One quarterly interim dividend of 1¼ per cent., amounting to £24,968 15s., has been paid during the half-year, and it is now proposed to distribute another of like amount, together with a bonus of 1s. per share, payable on the 20th April, which, with the two interim dividends and bonus paid for the first half-year, will make a total distribution of 6 per cent. for the year 1881. The balance, amounting to £51,876 4s. 5d., has been carried to the reserve fund, which now stands at £276,203 1s. 10d. The new Singapore-Batavia cable, which was referred to in the last report, was successfully laid and opened for traffic on the 24th November last, and the old cable, with the exception of a few miles temporarily left in the Gaspar Straits, was entirely recovered, and the greater part found to be in such condition as to be available for probable extensions when re-served on board the company's hulk at Singapore. The cable has, therefore, been taken into the company's spare cable stock at a moderate valuation. By this means the cost of the new cable is reduced to £64,363 11s. 5d., of which £34,363 11s. 5d. has been charged against the past year's revenue, as above stated, leaving a balance of £30,000 to be dealt with during the current year. An arrangement has been entered into with the Governments of Victoria and Tasmania for a reduction of the tariff over the Tasmanian cable from 4s. to 2s. per ten words, in consideration of a subsidy of £1,200 per annum, payable to the company by the two colonies. The new arrangement came into operation on the 1st January, and up to the present time has worked satisfactorily. No cable interruptions of importance have occurred during the half-year. Numerous small repairs have, however, been necessary, requiring the services of the company's maintenance ships for a considerable period. The South Australian Government land line between Port Darwin and Adelaide has been well maintained during the half-year. The directors have to record with deep regret the death, on the 25th October last, of their esteemed colleague, the Right Honourable W. N. Massey, M.P., who had been connected with the company since its inception. It is not proposed to fill up the vacancy. In accordance with the articles of association, W. McArthur, Esq., M.P., and G. G. Nicol, Esq., retire by rotation, and offer themselves for re-election. The retiring auditors, Mr. Henry Dever and Messrs. Quilter, Ball & Co., offer themselves for re-election.

GERMAN UNION TELEGRAPH COMPANY.

The report of the direction to the ordinary general meeting held at the offices of the company, No. 4 Werderstrasse, Berlin, on the 31st ultimo, runs as follows:—As shown by the accounts and balance-sheet submitted to you for the year ending the 31st December, 1881, the board of supervision was able, after placing 10 per cent. of the net profits to the credit of the reserve and renewal funds respectively, to declare a dividend for the year 1881 of 23 marks or 8¾ per cent., 12 marks or 4 per cent. of which was paid by way of interim dividend in the month of January last. Since our last ordinary general meeting considerable alterations tending to an enlargement of the sphere of our business have taken place with your consent. In the extraordinary general meeting of the 26th July last we reported to you on the reasons which made the establishment of a direct telegraphic communication between Germany and the United States of North America desirable independent of foreign land-lines, and in unanimously adopting our proposition you have shown that you mean to preserve to the company its position in Germany by attending to the requirements of the traffic. With the consent of the board of supervision we have availed ourselves of the powers granted us by you to increase the capital of the company by the amount of the then estimated cost of the new line, say 3,300,000 marks, or £165,000, by the issue of 5½ per cent. preference shares. With regard to the raising of the requisite funds and the taking over of those shares which were not claimed by the parties entitled thereto, according to the statutes, we have concluded an advantageous agreement with the banking house of Messrs. Emile Erlanger & Co., in London, by which agreement we have been enabled, in consequence of the competition between the several manufacturers, to procure the cable Greitsiel-Valentia, together with the subterranean land-lines belonging to it, for about £20,000 less than our engineers' estimate, and besides this to get an underground cable laid containing four wires from Emden to the coast. This latter cable is connected with the underground lines of the Imperial Administration debouching at Emden, and will in future prevent the interruptions of the land-lines near the coast of the North Sea, only too frequent heretofore during winter time. The construction and laying of the cable we have intrusted to the renowned Telegraph Construction and Maintenance Co., at the lowest tender received, particularly because the core offered us by that manufactory was superior in quality to those offered by the other applicants. All agreements have been concluded by us in accordance with the obligations imposed upon the direction under the German law, and also pursuant to the principles repeatedly pointed out to us by the Imperial Postal Administration. Here we feel called upon to express our cordial thanks to Mr. Weaver for the able and energetic assistance he afforded us in this direction. And in doing so we can only regret his having since been obliged to resign his place as a member of our board of supervision from considerations of health. The money not required out of the new capital we have invested according to the resolution of the board of supervision in 4 per cent. safe debentures, and have handed them over to the Imperial Bank for safe keeping. We hope that the laying of the new Valentia cable, which is near at hand, will be carried out in the same satisfactory way as has been the case with its manufacture. The new line will entail on us sundry increased expenses, viz., for patents, rent of ground in Ireland, &c. The telegraph traffic with America and England, however, has developed to such an extent, that we may hope for a fair return on our enterprise also for the future. We, however, regret to state that along with the bright side of our undertaking, viz., the conclusion of a new agreement with the Imperial German Post Office, the procuring of the British Government's licence for landing at Valentia, the conclusion of a new agreement with the Anglo-American Telegraph Co., ratified by the Imperial German Post Office, concerning the reservation of a transatlantic cable for the direct German-American traffic, we must record some drawbacks. In the storms of the month of October last unhappily our cable was broken about fifty nautical miles off the British coast. Although the Telegraph Construction and Maintenance Co. lost no time in despatching a vessel to undertake repairs, it was impossible to complete them before the 17th inst. This delay was occasioned partly by the unfavourable weather, partly by the unfortunate circumstance of the cable not having been correctly entered in the chart at the time of

laying. In order to preserve to our company its solid basis, we have been induced by the extraordinary claims laid upon the reserve fund for repairs of the cable to propose that you will adopt an appendix to Article 39 of our statutes, to the effect that our board of supervision shall be authorised, until such time as the reserve fund shall have regained its present height, to credit it with a sum up to further 5 per cent. of the net receipts.

HAMBURG-HELIGOLAND TELEGRAPH COMPANY.

THE report of the direction to the ordinary general meeting held at the offices of the German Union Telegraph Company, No. 4, Werderstrasse, Berlin, on the 31st of March, was thus worded:—The accounts and balance-sheet which we beg to submit to you have enabled our board of supervision to declare, as in the previous year, a dividend of 5 per cent. for the year 1881. Our apprehension that the law-suit we had commenced for the breaking of our cable would be decided against us has unfortunately proved correct. The Imperial Post-office, however, has been induced by the verdict of the Imperial Court to bring about between the Imperial authorities concerned the discussion of the question of an effective protection of the submarine cables which constitute nowadays quite an indispensable means of international communication. The regulation of this question is momentarily also being aimed at by means of international agreement. We have concluded an agreement with the Government of Heligoland, according to which that Government returns us *à fond perdu* for destruction the 60,000 marks shares held by them with which they had participated, as is known to you in the subscription for our line. After this agreement has been ratified by the British Government, we beg to submit to you a resolution for a reduction of the company's stock capital by 60,000 marks, together with corresponding writing off of the same sum from the cable account. At this moment our cable is interrupted near Neuwerk; its restoration, however, may be expected very shortly.

THE COMPANY FOR THE LAYING AND MAINTENANCE OF THE GERMAN-NORWEGIAN SUBMARINE CABLE.—The report of the direction to the ordinary general meeting held at the offices of the German Union Telegraph Company, No. 4, Werderstrasse, Berlin, on the 31st March, is thus worded:—As last year, so the accounts and balance-sheet we have the honour to submit to-day have enabled the board of supervision to propose for the past year payment of a dividend of 5¾ per cent., after putting by the amount fixed by the statutes for the redemption of the shares and contribution to the reserve-fund. According to the most recent tests taken, our cable is in good order and condition. We have again been put to considerable expense for the maintenance of the cable house, and of that part of the coast at Sylt where our cable lands.

GREAT NORTHERN TELEGRAPH COMPANY.—The accounts for the year 1881 show that the traffic receipts amounted to £236,060 14s. 2d. This interest, £6,336 12s. 2d., and sundries, £9,962 14s. 6d., together with balance brought forward, £22,250 4s. 11d., amounts to £274,610 5s. 9d. The total expenses for the same period were £74,254 3s. 10d., to which is added £10,000 for 5 per cent. interest on debentures and amortisation of 50 debentures, leaving a surplus of £84,254 13s. 10d., which it is proposed shall be appropriated as follows, namely: interim dividends paid on 150,000 shares, £75,000; extra dividend thereon, £37,500; addition to the reserve and renewal fund, £55,555 11s. 1d.; addition to the pension fund of staff, £1,111 2s. 3d.; remuneration to the board of directors, £1,500; which leave a balance to be carried forward of £19,688 18s. 7d. The total reserve fund will, with the above addition, amount to £218,186 14s. 11d.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY (Limited) notify that they have opened a station at Ceara in Brazil, the charges to which will be 11s. per word from all stations in England.

THE EASTERN TELEGRAPH COMPANY notifies the interruption of the South African Company's Zanzibar-Mozambique cable. The company's cable-repairing steamer will be immediately despatched for Zanzibar to restore the communication. Telegrams from the Cape will be sent on by steamer, which leaves Zanzibar for Mozambique in a few days, and the messages will also be transmitted by wire when the cable is repaired.

ELECTRIC LIGHTING IN INDIA.—The *Bombay Gazette* of the 16th ult. gives the following notice:—"Last evening the electric light was tried at the Crawford markets, and the experiment proved very successful. Three lamps were placed where the roads meet, and eight or nine were put up in the markets. The result was that a strong, pure, and soft light filled the building and was diffused over the road. The lights were on the Brush system, and were supplied by the Eastern Electric Light and Power Company. The trial having proved so satisfactory, there is a possibility of the municipality using the electric light for the markets, which may in that case be kept open until a later hour than they are at present. The municipality may also introduce the light into the Bandora slaughterhouses. The experiment last evening was watched by the municipal commissioner, and was conducted under the supervision of Major C. H. Strutt, managing director of the Eastern Electric Light Company."

THE JAY-GOULD CABLES.—The *Standard* of the 10th instant says:—"The effect of the Jay-Gould duplicate cable constructed and laid between Europe and America was expected to have materially cheapened the international cable communication between the eastern and western hemispheres, but it has had the contrary effect. The various English, French, and American cable companies have conferred together, resulting in an arrangement being arrived at to increase the present tariff of 1s. to 2s. per word, and arrangements are in progress to shortly give this effect."

THE GREAT WESTERN ELECTRIC LIGHT AND POWER COMPANY.—It is stated that the shares of this company were subscribed for more than four times over.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED) notify that the interest due the 15th inst. on their 6 per cent. debenture loan will be paid on and after that day at the Consolidated Bank, Threadneedle Street, E.C., where coupons should be left for examination three clear days before applying for payment.

THE ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).—The directors of this company have resolved, after placing £37,500 to the renewal fund, to declare an interim dividend for the quarter ending the 31st of March, 1882, of 5s. per cent. on the ordinary, and 10s. per cent. on the preferred stocks, both free of income-tax payable on the 1st of May to the shareholders registered in the books of the company on the 31st of March last.

THE ELECTRIC LIGHTING CONTRACT AND MAINTENANCE COMPANY (LIMITED) posted their letters of allotment late on Saturday evening last.

THE ordinary general meeting of the shareholders of Reuter's Telegram Company (Limited) will be held on Wednesday, the 26th inst., at noon, at the company's offices. The transfer books of the company will be closed from the 12th until the 25th inst. inclusive.

THE coupons of the Submarine Cables Trust due on the 15th inst. will be paid by Messrs. Glyn, Mills, Currie, and Co., between the hours of 10 a.m. and 2 p.m. The coupons must be left for examination three days previous to calling for payment.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations, April 12.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	11 - 11½	11⅛-⅜m. 11.-⅝
		Do. Do.	10	25 - 26	
150,000	1	Electric Light and Power Generator Co.	1	⅝- ¾	⅞-⅝ m.
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	52½- 53	
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until }	100	82 -83	81½ m. 81⅝. 2⅜ ac.
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref. }	100	23½- 24	23½ m.
130,000	10	Brazilian Submarine, Limited	10	10⅞- 11½	10⅞-⅞-11m.
16,000	10	Cuba, Limited	10	8½- 8⅝	8⅝ m.
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	
13,000	10	Direct Spanish, Limited	9	6 - 6½	
6,000	10	Do. 10 per cent. Preference	10	15½ 16½	
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 11⅝	11⅝ ac.
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	102 -105	
380,000	10	Eastern, Limited	10	10 - 10⅛	10⅛ m.
70,000	10	Do. 6 per cent. Preference	10	12⅝- 13½	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	102 -107	
192,750	10	Eastern Extension, Australasia & China, Limited	10	11⅜- 11⅝	11⅜m. 11⅜ac.
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	106 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	103 -106	
140,000	100	Do. do. registered, repayable 1900	100	103 -106	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	103 -106	
254,300*l.*	100	Eastern and South African Limited 5 per cent. } Mort. Deb. Registered redeemable 1 Jan. 1900 }	100	102 -105	
345,700*l.*	100	Do. do. do. To Bearer	100	102 -105	
22,050	10	German Union Telegraph and Trust, Limited	10	9½- 10	
163,330	10	Globe Telegraph and Trust, Limited	10	6¼- 6½	6⅞-⅞ m.
163,209	10	Do. 6 per cent. Preference	10	12½- 12⅝	12⅞ m.
125,000	10	Great Northern	10	13 - 13½	13⅝m. 13½ac
100,000*l.*	100	Do. 5 per cent. Debentures	100	102 -105	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	24 - 25	24⅞ m.
100,000	100	Do. 6 per cent. Debentures, 1886	100	101 -105	
17,000	25	Indo-European, Limited	25	29 - 30	29¾ m.
38,148	10	London Platino-Brazilian, Limited	10	4⅜- 5½	
12,000	10	Mediterranean Extension, Limited	10	1⅞- 2⅛	
8,200	10	Do. 8 per cent. Preference	10	8½- 9	
9,000	8	Reuter's, Limited	8	13½- 14	
280,000	Stk.	Submarine	100	269 -270	
58,225	1	Do. Scrip	1	2⅛- 2⅜	
4,200	Cert.	Submarine Cables Trust	100	103 -106	
37,350	12	Telegraph Construction and Maintenance	12	30 - 31	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -105	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1⅛- 1⅜	1⅛ m.
30,000	10	West Coast of America, Limited	10	4⅜- 5⅛	
150,000	100	Do. 8 per cent. Debentures	..	..	
69,910	20	Western and Brazilian, Limited	20	8¼- 8⅜	8⅜m. 8⅜ac.
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	105 -110	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	98 -101	
1,500	$1,000	Western Union of U. S. 7 p.c. 1 Mort. (Building) Bds.	$1,000	124 -129	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -105	
88,321	10	West India and Panama, Limited	10	1⅝- 2⅛	
34,563	10	Do. 6 per cent. 1st Preference	10	8½- 9	
4,669	10	Do. 6 do. 2nd do.	10	7 - 7½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1⅜- 1⅝	
200,000	1	Oriental Telephone Co.	½	⅜- ½	
100,000	5	United Telephone Co.	5	13¼- 13⅜	13½ m.

TRAFFIC RECEIPTS.

Eastern Extension, Australasia, and China Company. The earnings of this company for March amounted to £33,677, against £29,661.

Eastern Telegraph Company. The earnings of this company for March amounted to £48,824, against £51,206.

The Brazilian Submarine Telegraph Company. The earnings of this company for the past week were £3,855.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for week ending April 7th, 1882, were £2,580, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West Coast of America Telegraph Comanpy, Limited. The gross earnings—traffic and steamer—for month ending March 31st, 1882, were £3,490, against £1,635 for the corresponding period last year, showing an increase of £1,855.